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OUR TWO BRAINS.

By Richard A. Proctor.

(*Continued from p.* 102.)

SUGGESTIONS FOR THE PRACTICAL APPLICATION OF THE THEORY.

IT has been shown that the faculty of speech depends either wholly or mainly on the left side of the brain. A lesion in a particular region of this side produces the loss of the faculty of expressing ideas by spoken words. Out of more than a hundred cases of this peculiar disease —*aphasia*—only one is known (and that case is doubtful) in which the right side of the brain was diseased. This seems to show that the two sides of the brain are distinct one from the other. At first sight, however, the idea might suggest itself that this evidence tended to prove that the two portions of the brain discharge supplementary functions. If the left side thus perform duties with which the right side has nothing to do, presumably the right side may perform duties from which the left side is free. This, indeed, would appear to be the case; but this is not a necessary distinction; it may be regarded rather as the result of habit, unconsciously exercised of course, since (as yet, at any rate) we do not possess the power of deciding that we will use this or that side of the brain. It appears that usually the left brain is used in speech, as the right hand is used in writing; that a disease in the particular part of the left brain on which speech depends, causes *aphasia*, precisely as a disease of the right hand destroys the power of writing (until the left hand has been trained to the work); and that by training both brains we should render this particular form of cerebral disease less likely to cause loss of speech, much in the same way that by training both hands to write, we should diminish the chance of any such cause as disease or accident depriving us of the power of writing.

Where the power of articulation is lost, it is not the mere power of moving the muscles of the tongue, larynx or chest, which is lost, but the memory of the mode of directing the movements of those muscles. In many cases, says Brown-Sequard, "a patient could move the tongue in any direction, could move the larynx, and utter sounds very well; but could not articulate, the mental part of the mechanical act being lost, not the mechanical action itself."

Sight affords evidence that the distinct action of the two sides of the brain is not incompatible with the completeness of the power possessed by either. Wollaston held that the right side of the base of the brain is the centre for sight in the two right halves of the eye—that is, the half of the right eye towards the temple, and the half of the left eye towards the nose; while the left side of the base of the brain is the centre for sight in the two other halves—the outer half of the left eye and the inner half of the right eye. If this were so, the two halves of the brain would be, so far as sight is concerned, absolutely supplementary to each other, insomuch that a disease of either half of the brain would render sight imperfect. It is not altogether true, however, as Brown-Sequard states, that only one-half of each object would be seen, for the whole of an object may fall on either half of the retina. But objects looked at full front would thus be divided. If the left side of the brain were affected, the left halves of the eyes would act imperfectly—that is, the left halves of the visual field within the eye; so that, in point of fact, objects towards the observer's right would be unseen, and *vice versâ*. Wollaston himself was troubled occasionally by a defect of this kind. Trying one day to read the name of an instrument—the barometer—he could read only "meter," the other part of the word, "baro," being invisible. Agassiz was similarly affected. And many patients who are afflicted with certain disorders of movement implying brain disease have the same trouble—they see only half of objects towards which the eyes are directly turned. Nor is this the only evidence which at a first view seems to demonstrate Wollaston's theory. If the theory were true we should expect to find that when only a small part of one side of the brain—or, rather, of that region on which sight depends—was affected, then only the half of one eye would be deprived of sight. This has been found to be the case. And, naturally, we should expect that if the other part of the region (of the same side of the brain) were affected, then the corresponding half of the other eye, and that half only, would be deprived of sight. This also has been found to be the case. Nevertheless, Wollaston's theory has to be abandoned because it does not account for all the facts, and is opposed by three decisive facts at least.* It has been shown in many instances that a disease in one half of the brain will produce complete loss of sight (i.) of the two halves of the eye on the same side as the diseased brain; or (ii.) of the two halves of the eye on the opposite side; or (iii.) of the two halves of both eyes. Manifestly, then, there is no necessary association between either side of the brain and the sight of either eye, or of the two halves of either eye. Each side of the brain possesses apparently the *potentiality* of rendering sight perfect for both eyes. Admitting this, it is clearly a point of great importance to inquire whether both sides of the

* It is singular how seldom the true rules which should guide us in selecting and rejecting theories are recognised and understood. Over and over again we see it assumed, if not stated, that that theory which accounts for the greatest number of facts is to be adopted as the most probable. This is not by any means the case. The true theory must, in reality, accord with *all* the facts, though we may not be able to show that it does. Now, if a theory accounts for several of the facts, and is not opposed by a single one, it has a much better claim to be adopted provisionally as the most probable, than another theory which accounts for a greater number of facts, or even for all the known facts save one, but is manifestly opposed by one fact. This is a rule of the utmost importance in science, because often it enables us to select the true theory, not by overpowering testimony of evidence in its favour, but by consecutively rejecting all other possible theories.

XUM

brain, or the two brains, may not each be trained to discharge this duty; for the disease of either would no longer destroy or seriously impair the power of sight.

The next point to be considered is that of gesture. It is maintained by Brown-Sequard that the left side of the brain chiefly controls the gestures, and this for the simple reason that the left side of the brain guides chiefly the movements of the right side of the body, and it is chiefly with the right arm that gestures are made. But it also appears likely, from certain pathological facts, that even the motion of the left arm, so far as gestures are concerned, depends on the action of the left side of the brain; for it is found that patients who have the left side of the brain diseased commonly lose the faculty of making appropriate gestures with either the right or the left arm. It has, however, happened in a few cases that the disease of the right side of the brain has led to a loss of the power of making gestures. It need hardly be remarked that this exception no more opposes itself to the general theory of the duality of the brain than does the fact that a certain proportion of persons are left-handed, or one may say left-sided.

There is a difficulty in determining how far writing depends on the left side of the brain, because disease of that side is not uncommonly accompanied by paralysis of the right arm and hand, and in such cases we cannot determine whether the power of writing is lost on account of a real loss of memory of the relation between written symbols and the ideas they express, or simply through the effects of paralysis. However, it very seldom happens that paralysed patients have lost altogether the use of the fingers and are unable to make the least sign. In fact, it is found that in many cases they can imitate writing placed before them (oftener if the handwriting resembles their own) while they are unable from memory to write anything, or, at all events, to express ideas by writing. The disease is called *agraphia*. In many patients suffering from this disease the right arm is perfectly free from any sign of paralysis, but a portion of the left side of the brain has been diseased. It would appear, therefore, that written language, like spoken language, depends on the left side of the brain.

It is also known that the power of reasoning depends on the left side of the brain more than on the right. In cases of insanity the left side of the brain has more frequently been found to be diseased than the right side.

(To be continued.)

ON TERMITES.

By Surgeon-General R. F. Hutchinson, M.D.

(Continued from p. 104.)

TERMITES have the same family arrangements and the same stages of development as their darker brethren, and share with them the crowning wonder of a wonderful life in the terminal swarm of the male and female winged insects. That of the ant is an unnoticed affair; that of the termite upsets the whole household by night and the whole neighbourhood by day.

They never swarm out here until about twenty-four hours after rain, and never, except during the rainy months—June to October. The "secret of water" is as necessary for the last transformation scene of the termite as for rousing the frog from his estivation. In the case of the former, it is more difficult to understand the close connection between moisture and termite perfection, because the condition brings with it no alimentary advantage. I believe the secret lies in the fact that moisture is essentially necessary to the unfolding of their large and delicate expanse of wing, for the process would be embarrassed, if not arrested, by the fiery blast of the hot wind which precedes the rains.

But, then, what is the use of the wings? It is certain that fertilisation does not take place during flight, and, from the very early wing-dropping, it is equally certain that these delicate organs are not necessary for the purpose. What, then, the necessity of the swarm? I believe it to be a provision of nature for lessening the species by bringing it into contact with the host of devourers ready to hasten to the feast either by day or night.

If these were not available to lessen the swarms, and its units returned to the earth whence they came, then the soil would very soon be dominated by these ruthless devourers. My remarks have hitherto only applied to their ravaging *inorganic matter*. Many a tree do they kill by barking; many a choice garden-plant, roses especially, do they similarly destroy; while their havoc among vegetables, especially potatoes, is very serious; nor do strawberries escape their notice.

Let us now try and watch a swarm *ab initio*, and in this outside mud house-wall we have an opportunity. While casually passing our eyes across it, we note the sudden appearance of a pinhole, and out of it the inquisitive antennæ of a worker, exploring in every direction. Knowing what is going to happen, we closely watch, and presently the antennæ are followed by the body of the worker, who proceeds to examine all round the hole, and is joined in the survey by a second worker. Apparently, both are dissatisfied, and begin enlarging the hole with their mandibles. While so engaged, the brownish-black mandibles of a perfect insect appear, and, with a mighty effort, it squeezes out of the hole, stops to breathe a moment, and then takes flight. More workers pass out of the hole, and great excitement prevails as, one by one, the perfected insects emerge. The same scene is being enacted at other openings which have suddenly appeared in the wall; and now it is covered with fluttering termites and excited workers.

As you gaze you are enveloped in a cloud of flyers, and can see that it is rising high into the air. Watch, and you will soon see that kites, crows, king crows, jays, mynas, sparrows—nay, the whole feathered race—are flocking to the feast, and that below, the poultry-yard, led by the guinea-fowls, are similarly occupied.

Note how laboriously the kites feed: each termite is seized by the claws and then conveyed to the beak; the other birds charge ruthlessly into the swarm with open beaks, and seize all they can. If this flight occurs towards dusk, you will find bats, even the frugivorous flying-foxes, and little owls joining in the revel.

After watching the flight for about twenty minutes, you will find that the survivors have alighted, and are now chasing one another in amorous pairs. This is the period of fertilisation.

Turn we now for a moment to the wall whence the swarm issued, and we shall find that the workers have carefully plastered up all the holes of exit, and the recent scene of busy activity is now bare and deserted.

Resuming our inspection of the perfect insects, we shall find to our amazement that they, too, have disappeared, and that naught remains of the great rush into life and activity but the disjected wings which thickly strew the ground. The disappearance in a room is still more marvellous, for within its walls you can imagine fewer places for retreat or concealment; yet, under your very nose the survivors of the swarm escape, and you can't say how.

The sudden appearance of a swarm at dinner-time, especially if there are lights on the table (as in the

abodes of Griffs), is too dreadful to contemplate, and impossible to describe; you have to contend with termites in your drink, termites in your soup, termites in the food you are conveying to your mouth, termites in your nostrils and ears, termites in your whiskers and hair—termites everywhere. So you are obliged to have all lights hastily removed from the table, and patiently await the disappearance of the swarm. A most fatal trap can be rapidly constructed; bring in a shallow tub with three to four inches of water, and put therein a protected light. In a very short time, a mass of drowned insects, equal to the depth of water will fill the tub, and upon them, just out of the water, anxious hundreds will be chasing one another over the bodies of their kindred.

I have shown the enemies to which an out-door flight is exposed; within doors greedy foes also await them in the guise of black ants, cockroaches, spiders, musk-rats, and lizards, and it is amusing to watch one of the latter with the back of the wall shade as its hiding-place; it cannot catch the termites buzzing about the lamp fast enough, and is already fully distended with those it has swallowed, so much so that it is obliged to halt with the wings of the last victim sticking out of its mouth like horns.

To return to the disappearance. How it is brought about I cannot positively say, for I have never been quite able to unravel it; but the following is my presumption:—Both males and females retreat under ground, the former only to die, the latter to initiate a new colony. Her first eggs hatch workers, the first duties of which are to build in the enlarging queen, and then attend to the further ramifications of the colony. I have kept the wingless insects under glass, and found that, after a time, the chasing ceased, and the female remained stationary, elevating her abdomen in the air, and quivering it in a curious manner, the male taking no notice of her. In all these experiments, having no earth to return to, both insects died in a few hours, the male always first.

The wing-dropping is very remarkable; it is not a casting-off of the whole structure, but a snapping off below the articulation, and this discard takes place exactly at the proper moment—*i.e.*, when the period of flight is over; seize a perfect insect when emerging from its hole, and you may hold it firmly by the wings; take it prisoner twenty minutes later, and you will find that it deftly raises its abdomen, as an earwig does in folding up its wings after flight, and in that act instantaneously snaps off its wings, leaving them in your fingers.

And this means that the wonderful machinery of muscles, blood-vessels, and nerves accessory to flight, is only required for a performance of twenty minutes, is then quite lost in the expiring male, and virtually so in the expanding queen-mother.

Exact representation from life of a Queen Termite. Colour, above, light brown, with deep brown marks; below, pale brown. Length, 2·3 in.; breadth, ·65 in.; weight, 8·80 apoth.

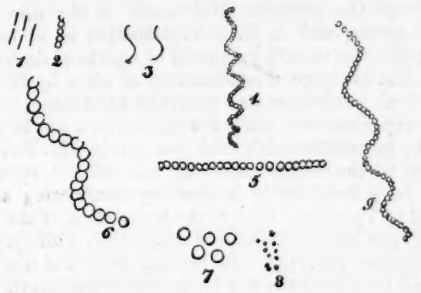
The India-Rubber, Gutta-Percha, and Telegraph Works Company will pay a dividend of 10 per cent., making 15 per cent. in all for last year.

* Exact size of worker.

PLEASANT HOURS WITH THE MICROSCOPE.

By Henry J. Slack, F.G.S., F.R.M.S.

In Vol. III. of Knowledge, p. 322, will be found one of these papers devoted to the minute organisms which produce various so-called zymotic diseases; that is disorders consequent upon their action as ferments. The annexed



figures, repeated from that paper, will suffice to show those new subscribers who may not be able to refer to it, what appearances some of these micro-ferments present. Figs. 1 and 2 show the form of *Bacillus tuberculosus* (consumption germ) magnified respectively 500 and 1,000 times linear. The spirals belong to another group (*Spirillum*), and move with a quick and elegant corkscrew motion. Figs. 5 and 6 show kinds common in decomposing infusions. Either animal or vegetable matter may be carried to the putrid stage by some of the micro-organisms; while others act like yeast, and instead of breaking up the matter altogether, resolve it into simpler forms. The fermentation of sugar is an example of this. The carbonic dyoxide (carbonic acid) which is given off consists of one atom of carbon and two of oxygen. The alcohol that is formed is a much more complex body. It is represented by the symbol C_2H_6O, the figures showing the number of atoms of the several elements—two of carbon, six of hydrogen, and one of oxygen. Ferments differing from yeast can effect still further changes in alcoholic liquors, turning wine and beer sour, or giving it the unpleasant taste and smell of rancid butter. All microscopists should watch the development of the yeast-plant during alcoholic fermentation, and familiarise themselves with the appearance of the micro-ferments of the bacteria and spirillum character sure to appear in hay infusions.

All the functions of life are carried on by changes in highly complex bodies, of which the protoplasm of the infusoria may be taken as the type. The whole group of albuminoid bodies is built up of a plurality of atoms of carbon, hydrogen, oxygen, nitrogen, sulphur, &c., in various proportions, and the micro-ferments that develop in the human body act in different ways, according to their kind; some producing changes required for nutrition and health, and others destroying structure that is wanted (like the bacillus of tubercle in the lung), or giving rise to some poisonous product that infects the blood. All highly complex instances may be roughly likened to the structures children build up with imitation bricks, and it is obvious that with a great number of these bricks all sorts of patterns can be obtained. Animals and plants require their atoms to be built up in certain patterns, and in none others, and as the building-up must be definite and regular, so must the unbuilding be for health to be maintained. The right ferments act according to what may be called the

architect's plan; the wrong ones do both their construction and their destruction in a mischievous way.

If an infusion of hay is kept for some time, various species appear in succession. This is partly because some have a quicker rate of growth than others, but also because some microferments, at one time, make the solution fit for certain creatures to develop in, and other ferments effect further changes that are adapted to other kinds.

The above remarks are intended to introduce a brief account of the progress lately made in the discovery of disease germs, and in their modification so as to render them promoters of safety, instead of agents of destruction.

The first evidence of attenuation of virus by cultivation under fresh conditions was obtained by Jenner, and more recent experimenters have shown cow-pox can be given to cattle by inoculation with small-pox germs. M. Bouchardat, alluding to the controversies on this subject, says, "that which rests indubitable is that by vaccinating after the method of Thielé and Ceeley, the inoculation of the parasite of small-pox has been rendered inoffensive, while preserving its protective property. In passing from the man to the cow, and back from the cow to the man it has lost its noxious properties and retained its useful ones."

The microferment producing measles (*rouget*) in pigs has afforded curious results in the experiments of Pasteur and Thuillet. Its transference from the pig to some animals increased its virulence, while in other animals it has diminished. It killed pigeons in a few days, and was transmitted from pigeon to pigeon in a virulent state. From pigeon back to pig it was much more virulent than from one pig to another. From pig to rabbit it was generally fatal to the latter, and continued so when passed from rabbit to rabbit. But, says M. Bouchardat, "cultivations of germs in the blood of these rabbits in a sterilised medium became more and more easy and abundant; the microbe changed its aspect a little, becoming stouter than in the pig, and sometimes shaped like a figure 8, without filiform elongation." After successive cultivation in rabbits, its action upon pigs became less virulent. It no longer killed them, but acted as a preservative against their own form of the disorder.

In Pasteur's experiments with the virus of rabies, the saliva of mad animals was found to contain divers organisms; but as the disease affected the brain, the parasite was sought for there, and in the spinal marrow and in the nerves, especially the pnemogastric.* M. Bouchardat tells us in his *résumé* that "these parasites, of one species or another, may develop in man or animal up to a certain point without occasioning disturbance; but the day comes when, from their numbers or their attacking certain parts of the nervous system, the terrible symptoms of rabies, or cerebral syphilis appear." The precise symptoms of the madness depend upon the parts of the brain that are attacked. The virus of this terrible disorder augments by its cultivation in certain animals, as when transferred from rabbit to rabbit, or guinea-pig to guinea-pig, or from these animals to the dog. From dog to monkey, and from monkey to monkey, the poison is attenuated, and can be so reduced as not to be injurious, but, on the contrary, a preservative to a dog.

The microbe-producing septicœmia (blood-poisoning) admits of similar modification. M. Pasteur has saved thousands of cattle, sheep, and poultry from the diseases produced by microbes, and he hopes that hydrophobia may in time be extirpated. Besides the security against terrible diseases affecting men and animals by the method of inoculating with modified germs, the new researches may lead onwards to the discovery of dietetic or medical methods of rendering men and other creatures unfit for the exhibition of the virus of disease microbes. Two things seem probable: one, that of producing a state of constitution in which the disease germs cannot grow at all; the other, that of compelling those that do grow to assume an innocent form.

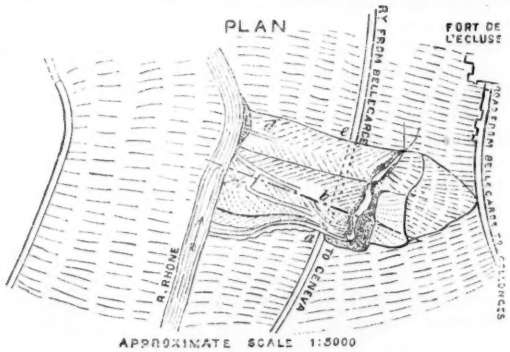
Besides reducing the virulence of disease-microbes by cultivating them in certain animals, some may have it attenuated by growing them in the presence of free oxygen, while to others of Pasteur's *anerobic** family this gas is fatal. Temperature is also an important element in determining the properties of microbes. M. Varigny, in a paper on these parasites, states that the malignant pustule sort does not grow in birds, because their temperature is too high to suit it. Microbes, also, have their battle of life against each other when their needs are the same. The strongest then prevails, and it is fortunate when it is the least mischievous.

No microbe can be identified as the cause of a particular disease unless that disease can be produced by inoculating some animal with it. Koch's *cholera bacillus* is not believed in because it does not fulfil this condition. If the able experimenter had not been acting as a State official detective of the cholera poison, he would probably have exhibited greater caution.

* The pnemogastric is the longest of all the cranial nerves, as it supplies not only the organs of the voice and of respiration, but also the heart and stomach.—Mivart, "Elementary Anatomy."

A REMARKABLE LANDSLIP AND ITS CAUSE.

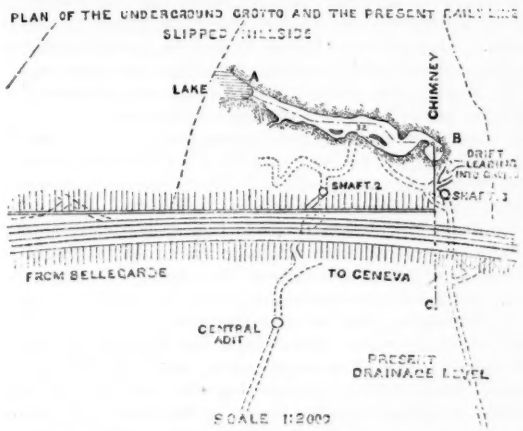
At the end of December, 1882, after several days' incessant rain, the traffic on the Bellegarde and Geneva branch of the Paris, Lyons, and Mediterranean Railway was stopped by slips on the hillsides of enormous dimensions, which occurred near Fort de l'Ecluse, about seven miles from the Swiss Frontier. At this point the line following the right bank of the Rhone, and about 140 ft. above it, passed through a tunnel about 160 ft. long, lined with masonry, which was completely destroyed by the



slipping of the hillside above it, the volume of material displaced being estimated at about 1,250,000 cubic yards. As the accident was evidently caused by an excessive increase of subterranean waters and their overflow into the loose ground of the hillside, it was decided to establish proper drainage works as soon as the line had been temporarily restored. For the latter purpose the ground was cleared by blasting on a large

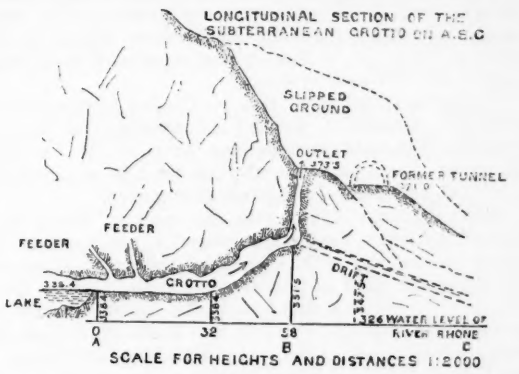
* *Anerobic*, growing without contact with air. The ferments that grow in air Pasteur calls *aerobics*.

scale, and an embankment about 130 ft. high formed to take the place of the destroyed tunnel. The new bank behind the slipped material was very high and steep, but as there was not time to secure it completely, as it was desired to re-open the line for traffic immediately, the protecting works were restricted to a certain amount of dry walling, where the marl rock projected most dangerously, the remainder of the surface being protected against rain and snow by a coating of tar. As the bank is about 75 yards long, and rises from 80 ft. to 100 ft. above the rail level, a force-pump and hose were employed to distribute the tar uniformly over the entire surface. The black cliff so produced has become a noticeable, if not a very enlivening feature in the scenery of the line; while for its particular purpose—that of a temporary protection of the ground—it has answered very well, the tar-covering not having suffered by the heat of the summer of 1884. This is in part due to the fact that the cliff is only exposed to direct sunlight during a short time in the day, as the river gorge is very deep and narrow. Smaller local slips have been stopped in a similar way by a further coating of tar.



To allow for the inevitable subsidence of the new embankment, the rails have been laid upon a grating formed of three superposed layers of sleepers, placed alternately parallel and perpendicular to the axis of the line.

Soon after the re-opening of the line in March, 1883, the permanent drainage works were commenced. These consisted of levels, mostly of elliptical cross-section, from 5 ft. to 7½ ft. high and 3½ ft. to 5 ft. wide, lined with masonry or concrete, which are driven into the bank from near the river level, generally perpendicular to the direction of the line. Although nearly a mile of these galleries had been driven up to November, 1884, the result was unsatisfactory, as no large amount of water was tapped, and small slips were continually occurring on the bank, until about the middle of the month, when a side drift from the No. 3 shaft, about 15 yards long, struck a cavern in the limestone rock, which passed upwards in a kind of chimney 70 ft. high, and downwards in an irregular gallery or grotto, about 200 ft. long and 45 ft. deep, terminating in a small lake of undetermined dimensions, with about 16 ft. depth of water close to the shore. The walls of the grotto are covered with stalactites, while those of the upper part or chimney are polished smooth by the numerous pebbles in it, which are all of a perfectly spherical form, and also well polished. The lake is about 34 ft. above the river and the top of the chimney about 114 ft. higher than the lake, which just brought it level with the spring of the arch of the original tunnel, and about 55 ft. horizontally distant from it, a position which sufficiently explains the constant influx of water, which could never be satisfactorily accounted for by the original



constructors of the line. The lake is evidently fed by numerous fissures, traversing the limestone forming the mountain, and together with the grotto and its outlet, forms a natural syphon. On the day of the great slip the water must have risen through the whole height of 114 ft., corresponding to a pressure of about 3½ atmospheres, giving an enormous flow. Since the new drainage level has been opened the discharge is very great, amounting, during the period of melting snows, to between 2,000 to 3,500 gallons per second, which issues with such velocity as to divide, and even to some extent keep back, the main current of the Rhone. The engineer in charge of the district, Monsieur Charbonnier, intends to provide for the permanent drainage by a new and shorter tunnel driven directly up to the lake.

The discovery of the cause of the accident has, so far, been of value that it has prevented a large outlay upon an alternative line, several of which—such as a transfer of the line to the opposite bank of the river, a long tunnel under Fort de l'Ecluse, and even the complete abandonment of the line between the Credo tunnel and Geneva, in favour of a direct connection of the Bellegarde and Evian line with the City of Geneva—were proposed and under consideration for some time. The cost of restoring the portion of the line destroyed by the slip is estimated at about £60,000, and the losses by the stoppage of the traffic may be estimated at about the same sum in addition.—*Engineer.*

THE ORIGIN OF COMETS.

By Richard A. Proctor.

ENCKE'S Comet has returned to our neighbourhood, and is now under observation. Yet to all ordinary appearance our skies are unchanged. Those who associate the return of a comet with the appearance of an awe-inspiring object, with long, sword-like tail brandished athwart the heavens, like those comets which have in past and recent ages terrified the nations, are disappointed when they hear that the comet of which the papers speak, and which Professor Young re-discovered a few days ago, and our telescopists are carefully observing, is one which cannot even be seen without telescopic aid. Yet to the student of astronomy the triumph is greater when one small comet is caught in the toils of mathematical analysis, and detected as it advances along its return track, than when the most glorious new comet blazes in our skies, and

by rapid changes of position and of form attracts the admiring attention of all men.

I propose to make the return of Encke's comet—the comet of shortest period known—the text for some remarks about the theories of comets more or less in vogue among astronomers, and especially those theories which relate to the origin of these bodies, or at least their introduction into our solar system.

It may be remembered that at the last meeting of the American Association for the Advancement of Science, Professor Young touched on what he called the received theory of the origin of comets, and what he admitted was a valid objection of mine against that theory.

What Professor Young calls the received theory is, I take it, neither a theory nor generally received—it only comes in company with a received theory. Schiaparelli, the ingenious chief of the Observatory of Milan, threw out, in 1866, the idea that the bodies which produce the star-showers of Aug. 10 and 11 (the *Tears of St. Lawrence* they were fancifully called in old times) are attendants on the Comet of 1862. When he had shown, which was an easy thing to do, that the apparent movements of those falling stars on the stellar heavens accord with the theory that they are moving in parallel tracks, touching (at any rate) the orbit of that comet at the place where it crosses the earth's track (a point passed by the earth on or about Aug. 10-11), it was felt that he had done something in support of his hypothesis. But when Professor Adams had shown, which was by no means an easy thing to do, that the bodies producing the display of November meteors travel in the very track of the comet of 1866 (known as Tempel's), astronomers saw that Schiaparelli's case was proved. It passed thenceforward from the condition of a mere speculation to that of a received theory.

This is the received theory about comets and meteors which every astronomer who can understand the evidence accepts without hesitation—*Meteors are bodies which travel on the tracks of comets.* More than that has not yet been shown, and more than that is certainly not received by astronomers as a body.

But Schiaparelli suggested more. He threw out a speculation concerning the origin of comets based on his established theory as to the connection between comets and meteors. This speculation would explain, if established, the way in which meteors travel on the tracks of comets. It ran as follows:—Amidst the interstellar depths are flights and clouds of meteoric bodies, which from time to time are drawn out of those depths by the attractive influence of the sun. Were the sun alone in the universe they would be drawn towards him, sweep around him in greater or less proximity to his surface according to the course on which they chanced to be drawn, and so pass out again to the depths from which they came. But as the sun has a family of attendant planets and some of these are somewhat stalwart fellows, many of the meteor-flights drawn sunwards are so acted upon by the disturbing influence of Jupiter, or Saturn, or Uranus, or Neptune, or mayhap some outer and still unknown members of the family of giant planets, that they are deflected from their course and thenceforward travel on a closed path—elliptic, of course—around the sun. The place where the deflection took place remains thenceforward a part of the comet's path, which therefore seems to associate itself with the path of the deflecting planet, in such sort that, though the sun is the chief ruler of the comet, the planet which introduced it into the solar system retains a sort of secondary influence over the comet's movements. Should the comet chance to revisit the scene of deflection when the planet is passing the same place, potent disturbing influences may be exerted on the comet, which may even send it wandering yet once more into the domain of interstellar space whence, according to this speculation, it was drawn.

Now I pointed out more than eleven years since that this part of Schiaparelli's imaginings is entirely without foundation in known facts. We may *guess* that the interstellar depths are a sort of breeding-place for comets and meteor systems,—though why they should be so not even Schiaparelli has ventured a suggestion. We may imagine that in the interstellar depths there still remain the scattered fragments of such materials as, when gathered in, had formed our solar system with all its worlds; though why any such fragments should remain *there*, instead of responding to the influences which brought their fellows to the neighbourhood of our system, would remain still unexplained. Only five or six millions of years would be required to draw in matter to the sun from half the distance separating him from his nearest neighbour among the stars, and our earth's crust tells us of tens of millions of years already passed since the sun had gathered in his mass so as to shine as a sun upon the earth. But we may concede for a moment the possibility of the wandering meteor flights of interstellar space imagined by Schiaparelli. How are we thereby helped to an interpretation of the origin of meteor systems now in attendance on the sun? Not a whit, seeing that we have only succeeded in replacing one difficulty by another still greater.

If we suppose the meteor streams to have come into the interstellar depths from beyond, that is from the domain of some star, we have removed our difficulty only a step, and not a step bringing us any nearer a solution. That other star is a sun like ours, and if a meteor system came from it to us, we have the same difficulty in understanding how the meteor system came to be in the neighbourhood of that sun as we have in understanding it as belonging for awhile to our own sun. One may compare this attempt at a solution of a really serious difficulty to Sir William Thomson's well-known attempt to explain the origin of life in our planet. This he did by surmising that millions of years ago another planet was the abode of life, that that planet came unfortunately into collision with another or burst, and that some of the fragments after flitting from sun to sun a few times chanced in their passage through our solar system to encounter our earth, where, falling on good soil, the germs brought forth abundant life: development did all the rest. That planet may have inherited the germs of life from another which had burst or collided a few millions of years before, and so on: we may in fact adopt a theory of planetary life akin to the theory of individual life—*omne vivum ex ovo*—and say every live planet received its life from a planet which was full of life, but burst up. Schiaparelli's cometic speculation asserts in like manner that every meteoric system or comet now associated with the sun came here athwart the star depths from another sun with which, millions of years ago, it was in like manner associated.

All this, however, is not scientific theorising but speculation. There is no evidence in support of Schiaparelli's supposition. If it were established we should be as far off as ever from knowing the real origin of comets. But lastly, there happens to be demonstrative evidence against the theory:—

Take the November meteors, whose path crosses that of Uranus so closely as to show that Uranus was the planet which introduced this particular meteor system, if the theory has in it any truth at all. The November meteors, and of course Tempel's comet, in whose track they travel, cross the path of Uranus now with a velocity of $1\frac{1}{2}$ miles per second. A meteor coming to our sun from interstellar

space would cross the track of Uranus, if it chanced to come in the right direction, with a velocity of nearly 6 miles per second. Uranus, then, to do what certainly *has been done* if Schiaparelli's idea is right, must have abstracted a velocity of 4½ miles per second from every one of a flight of meteors travelling past it. Now it may be barely possible (I doubt if it is, but the calculations necessary are too abstruse to be entered on save for a very special purpose) for Uranus to abstract so great a velocity from a body travelling past him. If Uranus drew a body to himself from interstellar space, no other member of the solar system, not even the sun, interfering, he could give to the approaching body a velocity of 13½ miles per second; but he could not give anything like this velocity to a body rushing along by him with sun-imparted velocities, and therefore exposed for a shorter time to his influence. Moreover, in any passage by Uranus some part of the velocity abstracted or added in one part of the passage would be restored or taken away again in the remaining part. At the utmost, Uranus might abstract from a single meteor some 4½ miles per second of its velocity of 6 miles per second. But Uranus could not possibly produce the same effects on the members of a flight of meteors, however closely we may conceive them to be set. Some would have their velocities much less effectively reduced. And the deflections of direction would be also altogether different. Nothing could save a meteor-flight from being dispersed along widely divergent paths if it came near enough to Uranus to have the motion of any of its members sufficiently affected to make them travel henceforward in such an orbit as is actually pursued by the November meteors, which all travel along the same path.

This which is true of one meteor system or comet is true of all. Under no conceivable conditions could a meteor-flight be introduced into our solar system as Schiaparelli imagined. Hence a different theory of the origin of the families of comets associated with the giant planets must be adopted. We *must* in some way admit that every comet was once in the neighbourhood of one of the giant planets in the form of a closely-set flight of meteors. This being so, the natural explanation is that each comet started from a planet,—by a process akin to volcanic ejection, or in some such way. Now on the one hand the sun does eject bodies from his interior, in mighty eruptions which have been actually watched; and the planets when in the sunlike state may well be believed to have done likewise; and on the other hand there is evidence to show that even our small earth once possessed the power of ejecting meteoric bodies from her interior (Prof. Ball considers that some meteor-flights still in existence were earth-born).

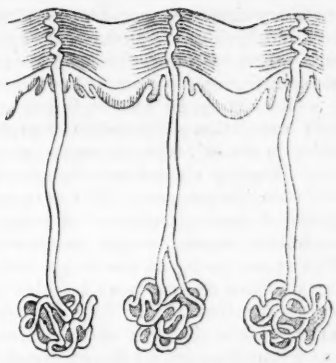
On the whole, then, the view seems suggested that comets like Encke's were ejected from the interior of the planet on which they are still found to be dependent.

THE PHILOSOPHY OF CLOTHING.

By W. Mattieu Williams.

II.—THE SKIN.

THE engraving below represents in outline a magnified section of a little bit of the skin of a human hand, cut across those wavy ridges that are visible to the naked eye on the fingers and inside of the palm. Three of these ridges are shown, the shaded upper part being the cuticle, and below it the cutis or true skin. The convoluted tubes are three of the sweat glands, the lower part of which lie immediately beneath the true skin, and the tube or duct rising from them passes through the true skin and cuticle, and opens on the surface of the latter, forming the "pores" of the skin. The waved structure of that part of the duct which passes through the cuticle I suppose to be adapted to the possible thickening of the cuticle, such as occurs when rough usage demands further protection—the effect of rowing on the cuticle of the hands, for example.



The number of these glands, with their ducts, thus opening on the surface of the human body has been variously estimated, from two millions to seven millions.

Every part of the body is provided with them, but they vary greatly in their distribution. On the palms of the hand there are about 2,800 to the square inch. They are fewer than this on the sole of the foot, but next in abundance there. Then they diminish successively on the back of the hand, the forehead, the front of the neck, trunk, and arms, where they are about 1,000 to the square inch; they are still fewer on the lower limbs, and fewest of all on the back, where they come down to about 400 to the square inch. Two and a half millions is the usual estimate of the whole number.

I present the picture of these glands and ducts, and state their numbers in order to convey to the mind of my readers a more serious conception of the importance of the "pores of the skin" than is usually entertained by the majority of those who speak of those pores. They are not merely the vacuous intervals of reticulated tissue, but the specially constructed outlets of special mechanisms having special functions to perform. We may safely infer that the importance of the function bears some relation to the elaboration of the machinery by which it is carried out.

More minute examination displays still further elaboration. Although the tube forming the coil and duct is but 1-300 of a inch in diameter, and, when all unrolled, is but a quarter of an inch long, it consists of an outer vascular coat continuous in structure with the cutis, and an inner epithelial or membranous coat continuous with the cuticle.

Physiological research confirms the inference suggested by the anatomical structure of these organs. They do much important work. They draw from the blood which circulates through the minute blood-vessels around them a sour, watery fluid, containing about 1½ per cent. of solid saline matter, urea, lactic acid, and other products of bodily waste; matter which, if left in the blood, would act as poison, and does so act when imperfectly removed, producing those general bodily disturbances with which we are too familiar as the results of "taking cold," *i.e.*, checking the functions of this sudoriparous machinery.

The importance of the excretory functions of the skin is strikingly shown by an experiment made by Valentin. In the month of September, when thirty-three years of age,

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and weighing about 54 kilogrammes (145 lb. troy, or 119 lb. av.), he took in twenty-four hours, 94⅓ oz. troy of solid and liquid food. Of this there passed off

By the bowels	6⅛ oz. troy.
Kidneys	46⅜ „
Skin and lungs	40⅛ „
	93

This under ordinary circumstances of temperature and moderate exercise. With violent exercise and exposure to high temperature, a robust man may throw off as much as four pounds of perspiration in the course of an hour. Valentin found that, while sitting, he lost 32·8 grammes per hour by cutaneous exhalation—insensible perspiration. On taking exercise in the sun with an empty stomach he lost 89·3 grammes. During violent exercise after a meal, with the air at 72° Fahr., he perspired 132·7 grammes.

A description of the consequences of suppressed action of the perspiratory organs would constitute a medical treatise. The inner lining of the lungs, and that of the whole of the digestive organs, is an infolded and modified continuation of the true skin. Any disturbance of the functions of the skin disturbs this continuous mucous membrane, and thus deranges all these internal organs more or less.

The fatal consequences of an extensive superficial scald, or burn, are due to internal sympathetic inflammation, rather than the direct superficial injury. Baron Dupuytren, the celebrated French surgeon, doubted the possibility of recovery when as much as one-eighth of the surface of the skin is sufficiently burnt to destroy the sweat glands, on account of the internal inflammation resulting from the suppression of their functions.

Fourcault varnished the skin of animals, and found that death followed in some instances in a few hours, but generally in one, two, or three days. In all cases the quality of the blood was altered, and the mucous and serous membranes lining the interior of the body were diseased.

I need scarcely state the very obvious demand for porosity in all our clothing which these facts so unanimously indicate; but shall have to discuss the question of how to obtain it presently.

I have already stated that the cuticle is a natural overcoat composed of ill-conducting material, which, with the fat beneath it, supplies us with some degree of protection against the chilling effects of the cool outer air. The true skin, which underlies it, is a vascular structure, a network of invisibly minute blood-vessels, so closely interlaced that, as everybody knows, we cannot insert the point of a needle without rupturing some of them and drawing blood.

The blood that enters these vessels comes from the arteries, is red, and charged with active oxygen. When it leaves them it is darker coloured, and some of this oxygen has combined with combustible matter; slow combustion has occurred, and heat has been consequently evolved. This general envelope of the body—the active, vascular, inner cutis—is, therefore, one of the vital heat-generators of the system. That inner continuation of the skin, the mucous membrane, which lines all the inner passages of the body that have any outlet, acts in like manner, and the same is probably the case with the serous membranes, or those which line the shut-up cavities.

I mention this at the outset, as it bears so directly on my subject, and more particularly because I find that many beginners in the study of physiology (and every human being should be a student of this subject) have been led by false analogy to regard the lungs as the furnace of the body, as the organ in which animal heat is generated. If it were so, the temperature of the lungs should be much higher than that of the rest of the body, which is not the case.

The arterial blood carries the oxygen taken in by the lungs to all parts of the body; the venous blood carries from all parts of the body the carbonic acid which is thrown out by the lungs; the combustive combination takes place throughout where the capillary blood-vessels are distributed, and where the work of life is done. The bearing of this upon the subject of clothing will be understood when we reflect on the fact that a certain initial temperature is demanded for the origination and maintenance of this combustion.

Not only does the skin envelop the body in a warming sheath of mild combustive activity; but, by means of the sudoriparous apparatus above described, it regulates the heat thus generated in the skin itself, as well as that similarly generated internally. It has a cooling as well as a warming efficiency, as I shall explain more fully in my next. I merely add here that, although artificial clothing cannot imitate the actively heating functions of the true skin, it may, when properly constructed, co-operate as a protection against excessive heat, as well as against the too rapid cooling of the body.

PLANT LIFE AND PLANET LIFE.

By Richard A. Proctor.

WHEN we look at some noble tree, one of the monarchs of the forest, with giant trunk and outspread arms, mighty to resist the fiercest storm, extending its long roots to "grip the hard bowels of the solid earth," it seems incredible that that vast bulk, with all its multiplicity of detail, with all its wealth of vitality, can have grown from a seed which a child could have held in the hollow of its hand. To some insect race dwelling within the compass of that tree, or perhaps passing its whole lifetime within but a small portion of the tree, the thought would have been inconceivable that the tree could have grown at all. One can picture the holy horror and pious grief with which such creatures, could they reason about their surroundings, would reject the idea that even a twig of that tree was a product of a process of development. "This," would they say, "is to set on one side the Creator in the name of Evolution. Those who thus fondly imagine that a twig has grown, will tell us next week that a bough has been developed; nay, they will not stop there, but one day we shall find the monstrous doctrine that the whole tree, this glorious universe of leaves in which our own twig home is set, has been evolved. May they not even tell us one day that this tree is but one of many trees, and that the whole system of trees has been formed by some process of evolution?" While we can well believe that those who rejected this monstrous doctrine of tree and forest development would err thus wildly, we can imagine also that those bold thinkers who recognised the evidence of such development would form wild and fanciful ideas as to the way in which the tree had been developed. Some might imagine that the tree had been formed from a vast cloud by a process of contraction. Others might imagine that the aggregation of rain drops and the dust of the air had formed that beautiful and complicated mass of verdure. Or other theories might be formed as far from the truth as we, with our wider knowledge, know it. Do we smile at such laboured nonsense? Mayhap our own ideas about the development of the solar system are as wide of the truth or even far wider. Our objections against the very doctrine of development as

extended to the solar system and to systems of such systems may be not less absurd. To higher orders of intellect than ours, the development of the whole universe, as we know it, may appear as clear and certain, its progress as beautiful and regular, as the growth of a mighty oak tree from an acorn, or the development of an animal from the germ. It is well to remember that the hatred which many entertain against the doctrine of development as applied to solar systems and stellar galaxies is not in reality a sign, as they imagine, of humility, but is an effort to avoid the recognition of the nothingness of man in the presence of the infinities of space and time and vitality presented within the universe of God.—*Newcastle Weekly Chronicle.*

FUTURE ARCTIC WORK.*

By Lieut. Greely.

IT has been intimated that my opinion upon the propriety and advisability of future Arctic exploration, as well as regarding the methods to be adopted therein, would be of interest to the general public. At some near day this subject may be treated more fully than space here admits.

There are five routes by which attempts have been made to reach the goal of Arctic ambition—the North Pole. The Behring's Straits route has probably been closed for many a year by the unfortunate issue of the expedition which was commanded by the lamented De Long. The highest latitude ever reached in that direction was by De Long in the *Jeannette*. The lack of land to the north-west forbids any attempt in that quarter, for all authorities on Arctic exploration are quite agreed that land is essential to success. In addition the south-east current very largely increases the danger, for a vessel once beset by the pack inevitably drifts to destruction. No ship which has been caught in that ice has ever escaped from its grasp, and no hero has ever returned to tell the tale until the indomitable will and tireless energy of De Long, Chipp, and Melville landed the survivors of the *Jeannette* on the Siberian coast six hundred miles from their lost vessel. To the north-west the terrible character of the paleocrystic pack met by McClure and Collinson on the west coast of Banks Land is equally unfavourable. Indeed, should an attempt be made in that quarter it should rather be from Baffin's Bay through Lancaster Sound and McClure's Strait, in the hope that a safe harbour could be found at Prince Patrick Island. It was by this route that Parry, in 1819, succeeded in reaching Winter Harbour, Melville Island, in a sailing ship, and returned without trouble the following year. In my opinion, however, no profitable or successful Arctic work can be prosecuted in the future in either quadrant to the northward of Behring's Straits.

Second is the Smith Sound route. By this route the nearest approaches to the pole by land and sea have been made. On June 30, 1872, Sergeant Myer, U.S.A., of the *Polaris* expedition, reached 82° 07′ on the shores of the Polar Ocean near Repulse Harbour. In May, 1876, Lieutenant Aldrich, R.N., reached the northern point of Grinnell Land, Cape Columbia, 83° 07′ north, 70° 10′ west. On May 12, 1876, Commander Markham, R.N., reached 83° 20′ 26″ north on the frozen Polar Ocean, at that time the greatest northing ever made. This latitude was surpassed by Lieutenant James B. Lockwood, U.S.A., who, carrying land twenty-eight miles further north than ever before known, reached 83° 24′ May 18, 1882, on the north coast of Greenland.

This has been called distinctly the American route, but, in my opinion, it is not the true road to the Pole. It has, however, been practically closed by Aldrich's remarkable trip on the shores of the Polar Ocean to the westward from Robeson's Channel and by Lockwood's magnificent and unparalleled journey along the north coast of Greenland. Another properly-appointed expedition by this route would require two staunch vessels with thorough outfit, entailing an expense of about 750,000 dols. By skilful management, hard work, and above all, good fortune, it could hope to beat Lockwood's latitude but a few miles, certainly not a degree. A single bad year for ice to the northward of Smith's Sound would insure failure. if it did not cause dire disaster. It is true that much work needs to be done to the westward of Hayes Sound in the vicinity of Arthur Land, but in that direction no high latitude could be attained. The Lady Franklin Bay expedition, which I had the honour to command, discovered that Cape Sabine is on an island (Bedford Pim Island) and is separated from the main coast by Rice Strait, which connects Rosse Bay and Buchanan Strait. By this route a vessel can safely reach Alexandria Haven from Cocked Hat Island by watching her opportunity. From that base Hayes Sound and its connecting waters can be easily explored. Such a voyage would entail less danger than is consequent on an ordinary whaling cruise.

The third route is up the east coast of Greenland. It was strongly advocated by the eminent geographer, the late Dr. Petermann, who fitted out the German expedition of 1868, and assisted in the second expedition of 1869. Both expeditions were commanded by Captain Koldewey. The highest reliable latitude ever attained on this coast was reached by Koldewey and Payer, in 1870—Cape Bismarck, 77°. The radical objection to this route is the wide belt of heavy and impenetrable drift ice along the coast, which is continually renewed by the immense quantities of ice drifting southward from the Polar Basin. As far as I know, no one now advocates it.

Fourth,—the Spitzbergen route offers a chance, though it be a slight one, of a very high latitude. It was here that Sir Edward Parry in 1827, leaving Hecla Cove, Spitzbergen, 79° 55′ north, 16° 53′ east, reached on July 23, by boat and sledge, 82° 45′ north. This latitude remained unsurpassed for fifty years till beaten by Markham in 1876, who, in turn, gave way to Lockwood in 1882. Owing to the southerly drift Parry's extreme point was but 172 miles from his ship, although he had travelled nearly five hundred miles, exclusive of double trips over the same road. I believe that by this route in a very favourable season, say one year in ten or twelve, a well-manned whaler could reach 84° or 85° north without serious difficulty. Such a voyage would entail the chances of an entanglement in the pack, with the possible destruction of the vessel, as happened to the *Hansa*. Under such circumstances, however, as the drift is southerly, ultimate escape by vessel or boats would, in all probability, be feasible. Involving as it does a violation of the fundamental principles of Arctic navigation, and entailing great and serious risks, such an expedition is not to be recommended.

Sir Edward Parry, the most successful of all Arctic explorers, after his remarkable voyage in 1819-20 through Lancaster and other sounds to Melville Island, enunciated the law of successful ice navigation in the Polar seas. He said:—"It can never be performed with any degree of certainty without a continuity of land. It was only by watching the openings between the ice and the shore that our late progress to the westward was effected, and had the

* From the *New York Tribune.*

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land continued in the desired direction there can be no question that we should have continued to advance, however slowly, toward the completion of our enterprise."

I think all Arctic authorities now concur in Sir Edward's opinion. To this has been added another proposition, which originated, I believe, with Sherard Osborne, but has of late years been strenuously supported by Commander Markham, R.N.: "To penetrate far into the unknown region, it is necessary to find a coast trending northward, with a western aspect." This is negatively substantiated not only by the loss of the *Jeannette*, but by the fact that the shores of east Greenland are practically inaccessible, while Spitzbergen can rarely, if ever, be coasted along its eastern side. Positive and convincing evidence is presented by Barent's voyage to the north point of Nova Zembla, Parry's to Melville Island, McClure's to Mercy Bay, Kane's to Van Renssalaer Harbour, Hall's to Thank God Harbour, Nare's to Floeberg Beach, Leigh Smith's to Eira Harbour, as well as by the whaler's yearly experiences in reaching the north water of Baffin's Bay. The cause of this may in a measure depend on the rotary motion of the earth, or other complicated phenomena, but a reasonable explanation is perhaps to be found in the north-easterly winds which prevail to such an extent in the Arctic regions.

Long sledge journeys are necessary for successful exploration, even after the vessel is in harbour at a high latitude. The easier the harbour is of access, so much greater will be the chances of ultimate success.

These conditions—continuity of land, with northern trend and western aspect, a secure harbour easy of access, together with good ice for sledging operations—are all fulfilled in the fifth route, *viâ* Franz Josef Land.

(To be continued.)

THE SPEEDWELL CYCLING EXHIBITION.

IF proof were wanting of the wonderful improvements which have been wrought in the construction of the "steely steed" during the last few years, no better method could have been devised for furnishing it than that adopted by the executive of the Stanley Bicycle Club in inaugurating the annual exhibition of bicycles, tricycles, and accessories in London, now well known as the Stanley Show, the success of which was so complete as to induce the Speedwell Bicycle Club Committee to take up the cue and provide a similar pantechnicon for Birmingham. This latter exhibition, which has also gained public favour, and has increased in magnitude and importance each year since its establishment, no doubt owes much of its success to the fact that a fair proportion of the cycling industry of England is centred in the "midland" metropolis. The expense of supporting two separate exhibitions in London and Birmingham was so great that many of the manufacturers this year decided to exhibit at the Speedwell Show only, with the result that the exhibition held at Bingley Hall, formally opened by the Mayor of Birmingham (Alderman Martineau) on the 5th inst., was especially interesting. As in former years, the body of the hall was occupied exclusively by the various exhibits, whilst the galleries were devoted to the trial of machines. The arrangements were in every way perfectly satisfactory, and the committee of management are to be congratulated on the result of their fourth annual venture.

Want of space precludes the possibility of reviewing the whole of the exhibits, and our remarks will therefore be confined to those which appear to be most worthy of distinction.

The stand occupied by Messrs. D. Rudge & Co., of Coventry—which was in a central position, and occupied the whole length of the building—was the largest display of any one firm in the show, and included no less than eighty-one machines of the highest class, style, and finish. The celebrated Rotary was, of course, a prominent feature, for the many wonderful performances which have been accomplished on this machine have rendered it—and deservedly so—a very popular "mount." Another specialty was a central-geared racing tricycle, made of the highest-quality materials, and weighing only 43 lb., upon which the unprecedented feat of riding 50 miles in 3 hrs. 47 min. 40 sec. has been accomplished. In addition to several racing bicycles, Messrs. Rudge exhibited a new Safety bicycle, which is an exceedingly presentable machine.

Messrs. Humber, Marriott & Co.'s exhibits were very tastefully arranged, and presented quite a picturesque appearance. The secret of the fame attained by the Humber machines was fully illustrated by the high-class workmanship displayed in all this firm's productions. Not only is the quality of the component parts undeniable, but all the improvements that ingenuity and skill can devise are introduced into these machines. Several bicycles and tricycles were shown upon which most of last year's "records" have been accomplished. Messrs. Humber also exhibited a Safety bicycle, which is only of recent date, and has not yet had its record-beating abilities tested.

The Royal Machine Manufacturing Company were well to the front with a fine variety of Royal Mail bicycles and tricycles, one of the latest of which is a two-track central-gear double-driver, fitted with an improved break which can be applied and set to resist any pressure, as desired, without the rider having to retain possession of the actuating-lever. Another specialty exhibited is a two-track, convertible Tandem, with steering-wheel in front on the right-hand side, and one at the back on the left-hand side. This firm also has produced a Safety bicycle said to possess certain special advantages.

Almost facing the Royal Mail stall was that of Mr. Wm. Bown, of Æolus fame, who has brought forward many desirable improvements in connection with bicycles and tricycles; his most successful invention, however, is doubtless the patent Æolus adjustable ball-bearing, which has become an almost indispensable necessity. Mr. Bown, having established his undisputed right to the patent, has, we hear, been besieged with orders for the coming season's supply. The patent Æolus two-speed hill-climbing gear for tricycles and the double-driving balance-gear are also rapidly receiving recognition as important improvements. From practical experience, we can testify that the former is a decided acquisition to a tricycle; it enables the rider to apply greater power to the machine in ascending steep hills or when riding against strong head-winds, and on easy-going roads the gear can be instantly changed to speed. Mr. Bown's exhibit also includes an adjustable handle-bar, which, by simply loosening the centre screw and pressing a small spring, can be brought parallel with the wheels, thus enabling the machine to be "stabled" or packed in narrow limits. A varied assortment of every description of cycling accessories and fittings in all stages of production, including the patent handy bell for tricycles, forms a most interesting display.

Mr. James Carver, of Nottingham, had on view several tricycles and bicycles, which, on close inspection, proved to be of excellent workmanship and splendid finish. The tricycles were of the Humber type. The Tandem Convertible is constructed with open front-steerer, for lady

riders; the rear portion is an ordinary-pattern Humber, and easily detachable. This machine is sure to become a favourite mount.

Thomas Smith & Sons, of Saltley, had a large and imposing display, consisting of no less than forty-two machines. A prominent feature in connection with their tricycles is a screw-steering arrangement, which seems vastly superior to the old rack and pinion movement, obviating, as it does, the liability of the machine to swerve out of its course when going over any inequalities in the road. This firm also exhibited an improved break for bicycles, and several of the new Badger Safeties, together with two racing bicycles. The machines are generally turned out in a manner that does credit to the firm whose name they bear.

The St. George's Engineering Company have a nice assortment of bicycles and tricycles, including Sociables, Tandems, and Convertibles, all of which are identified by some special feature.

Messrs. Singer & Company show several splendidly constructed "bikes" and "trikes." The quality of this company's productions is sufficiently well known to need no eulogising here. Chief amongst their exhibits was the Apollo Tandem, which can be steered by either rear or front wheels, the back portion of the machine being of the Humber pattern. The Two-wheelers are really elegant machines, possessing many well-devised improvements, and being finished in a manner that cannot fail to give complete satisfaction to the purchaser. This is one of the oldest established firms in the trade, and the quality of all their productions is second to none in the Kingdom.

Mr. Adam Burdess, of Coventry, exhibited four of his well-known Sterling tricycles, each being distinguishable by some special features.

Messrs. Devey & Company, of Wolverhampton, may fairly claim that the quality of the materials employed in the construction of their machines is of the best, while their price is exceedingly low.

Frank Gibbons, of Wolverhampton, though a new-comer in the cycling trade, makes his *début* with an excellent collection of well-made Cunard bicycles and tricycles, and, if careful workmanship and superior finish will command patronage, then Mr. Gibbons may be ensured of success.

In addition to the manufacturers' exhibits, there was a magnificent collection of prizes (contained in three large show-cases) won by members of the Speedwell Club, the value of which is estimated at upwards of £4,000. Altogether, the Exhibition proved a great success. The attendance was in excess of former years, and the sales were fairly satisfactory.

OTHER WORLDS THAN OURS.

A WEEK'S CONVERSATION ON THE PLURALITY OF WORLDS.

By Mons. de Fontenelle.

WITH NOTES BY RICHARD A. PROCTOR.

THE FOURTH EVENING (*continued*).

"IF there are sixteen planets," said she, "Saturn must have five moons."

"'Tis very true," said I; "and two of these five are but lately discover'd; but there is somewhat that is more remarkable. Since his year makes thirty of ours, there are consequently in him some countries where their night is fifteen years long; and what can you imagine Nature has invented to give light during so dreadful a night? Why, she has not only given Saturn five moons, but she has encompass'd him round with a great circle or ring, which, being placed beyond the reach of the shadow which the body of that planet casts,* reflects the light of the sun continually on those places where they cannot see the sun at all."

"I protest," says the Marchioness, "this is very surprising; and yet all is contrived in such great order that it is impossible not to think but nature took time to consider the necessities of all animate beings, and that the disposing of these moons was not a work of chance, for they are only divided among those planets which are farthest distant from the sun—the earth, Jutiter, and Saturn. Indeed, it was not worth while to give any to Mercury or Venus; they have too much light already; and they account their nights (as short as they are) a greater blessing than their days. But pray, why has not Mars a moon too? It seems he has none, tho' he is much farther than the earth from the sun."

"It is very true," said I; "no doubt but he has other helps, tho' we don't know 'em. You have seen the phosphorous, both liquid and dry, how it receives and imbibes the rays of the sun, and what a great light it will cast in a dark place. Perhaps Mars has many great high rocks, which are so many natural phosphorus's, which in the day take in a certain provision of light, and return it again at night. What think you, madam, is it not very pleasant, when the sun is down, to see those lighted rocks, like so many illuminations at a birthday night? Besides, there is a kind of bird in America that yields such a light, you may read by it in the darkest night [!]; and who knows but Mars may have great flocks of these birds, that as soon as it is night disperse themselves into all parts, and spread from their wings another day?"

"I am not at all contented," says she, "with your rocks or your birds: 'tis a pretty fancy, indeed; but 'tis a sign that there should be moons in Mars, since Nature has given so many to Saturn and Jupiter: and if all the other worlds that are distant from the sun have moons, why should Mars only be excepted?"

"Ah, madam," said I, "when you are a little more dipt in philosophy, you will find exceptions in the very best systems. There are always some things that agree extremely well; but then there are others that do not accord at all: those you must leave as you found 'em, if ever you intend to make an end. We will do so by Mars, if you please, and say no more of him, but return to Saturn. What do you think of this great ring, in the form of a semicircle, that reaches from one end of the horizon to the other, which, reflecting the light of the sun, performs the office of a continual moon?"

"And must not we inhabit this ring, too?" says she, smiling.

"I confess," said I, "in the humour I am in, I could almost send colonies everywhere; and yet I can't well plant any there, it seems so irregular a habitation; but for the five little moons, they cannot chuse but be inhabited; tho' some think this ring is a circle of moons, which follows close to one another,† and have an equal motion, and that the five little moons fell out of this circle: how many worlds are there then in the vortex of Saturn? But let it be how it will, the people in Saturn live very miserably. 'Tis true, this ring gives light to 'em, but it must be a very poor one, when the sun seems to 'em but a little pale star, whose light and heat cannot but be very weak at so great a distance: they say, Greenland is a

* This statement gives a curious idea of the figure assigned to Saturn's rings by astronomers in Fontenelle's time.—R. P.

† Cassini's idea, in which he anticipated the views at present regarded as established.—R. P.

perfect bagnio in comparison of that planet, and that they would expire with heat in our coldest countries."

"You give me," says she, "such an idea of Saturn, that makes me shake with cold, and that of Mercury puts me into a fever."

"It cannot be otherwise," I reply'd; "for the two worlds, which are the extremities of this great vortex, must be opposite in all things."

"They must, then," says she, "be very wise in Saturn; for you told me they were all fools in Mercury."

"If they are not wise," said I, "yet they have all the appearances of being very phlegmatick. They are people that know not what it is to laugh; they take a day's time to answer the least question you can ask them; and are so very grave, that were Cato living among them, they would think him a Merry-Andrew."

"It is odd to consider," says she, "that the inhabitants of Mercury are all life, and the inhabitants of Saturn quite contrary; but among us, some are brisk and some are dull. It is, I suppose, because our earth is plac'd in the middle of the other worlds, and so we participate of both extremes; there is no fix'd or determin'd character; some are made like the inhabitants of Mercury, some like those of Saturn; we are a mixture of the several kinds that are found in the rest of the planets."

"Why," said I, "do you not approve of the idea? Methinks it is pleasant to be composed of such a fantastical assembly, that one would think we were collected out of different worlds. We need not travel abroad, when we see the other worlds in epitome at home."

"I am sure," says the Marchioness, "we have one great convenience in the situation of our world; it is not so hot as Mercury or Venus, nor so cold as Jupiter or Saturn; and our country is so temperately plac'd, that we have no excess either of heat or cold. I have heard of a philosopher, who gave thanks to Nature, that he was born a man, and not a beast; a Greek, and not a barbarian: and for my part, I render thanks, that I am seated in the mildest planet of the universe, and in one of the most temperate regions of that planet."

"You have more reason," said I, "to give thanks that you are young, and not old; that you are young and handsome, and not young and ugly; that you are young, handsome, and a Frenchwoman, and not young, handsome, and an Italian; these are more proper subjects for your thanks than the situation of your vortex, or the temperature of your country."

"Pray, sir," says she, "let me give thanks for all things, to the very vortex in which I am planted. Our proportion of happiness is so very small, that we should not lose any, but improve continually what we have, and be grateful for every thing, tho' ever so common or inconsiderable. If nothing but exquisite pleasure will serve us, we must wait a long time, and be sure to pay too dear for it at last."

"I wish," said I, "that philosophy was the pleasure you propose, that when you think of vortexes, you would not forget an humble servant of your ladyships."

"I esteem it a pleasure," says she, "while it diverts innocently, but no longer."

"I will engage for it till to-morrow," I replied; "for the fixed stars are beyond what you have yet seen."

(*To be continued.*)

According to the *Guernsey Star* the Customs Department has given notice that the provisions of the Customs Consolidation Act, 1876, with regard to the prohibition of foreign editions of English books, will be strictly enforced in the Channel Islands. It appears that in Guernsey the importation and sale of the American and Tauchnitz reprints of works by English authors has until now been practically unrestricted.

THE YOUNG ELECTRICIAN.

By W. Slingo.

(*Continued from p.* 103.)

In very many instances a means of some kind for holding our material while it is being worked is necessary. This is usually furnished by a vice, of which three or four types may be mentioned. It is eminently important that the work should be held firmly, but at the same time a caution against overstraining the vice may not be out of place.

Ex. XXV.—The ordinary table-vice, such an one as may be seen in the hands of a watchmaker, will in most cases answer the young worker's purposes, but it has a number of objectionable features about it, the most important of which is that when the jaws are opened to their fullest extent they cease to be parallel, and as a consequence have only a partial and very insecure grip upon the material placed between them. Moreover, the screw is subjected to a severe bending strain in consequence of the tendency on the part of the collar of the screw to set itself parallel to the inclined jaw.

Ex. XXVI.—A form of table-vice which is much more to be recommended for general use is that known as the

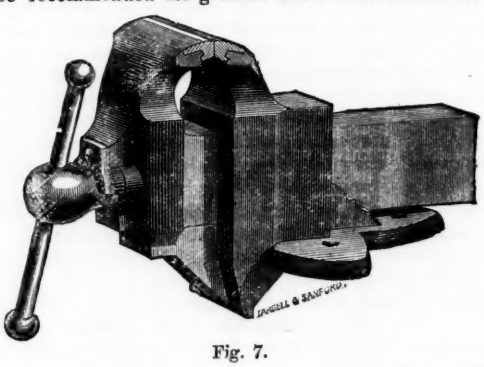

Fig. 7.

parallel vice (Fig. 7), in which the movable jaw remains throughout the whole range of the screw parallel to the fixed jaw. This is accomplished by attaching the movable jaw to a square bar of iron, which travels horizontally and passes through a corresponding square hole at the bottom of the fixed jaw. This form of vice is of somewhat recent introduction. It has the advantage that the screw is entirely enveloped by the horizontal bar of iron, whence

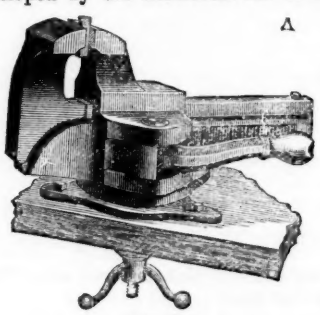

Fig. 8.

filings, &c, are prevented from getting into the thread. It may be obtained of Messrs. Chas. Churchill & Co., 21, Cross-street, Finsbury, E.C.

Ex. XXVII.—Another, and perhaps cheaper, form of parallel vice is the "Grip" vice (Fig. 8), which may also

be obtained of the above-mentioned firm. In working with this tool, the material is placed between the jaws, of which one may be moved to and fro with the hand and pressed up against the material. The material is then secured by turning a lever handle, to which is attached an eccentric cam, which, in turn, tightens the bar to which the movable jaw is attached.

Ex. XXVIII.—Fig. 9 illustrates a "hand" vice, which is very useful for manipulating small work, such as the heavier forms above referred to would be unsuited for.

* * * * * *

What is drilling? A process for boring holes in or through metals and other substances. This is accomplished by means of a "drill," consisting of a suitably pointed and sharpened piece of steel wire or rod, which is made to revolve more or less rapidly against the material, and so to cut a hole of the required size and depth. Two things are, therefore, essential, viz., the drill and the apparatus for revolving it, which is called a "drill-stock."

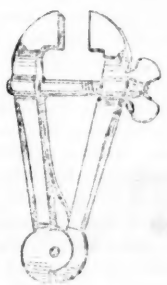

Fig. 9.

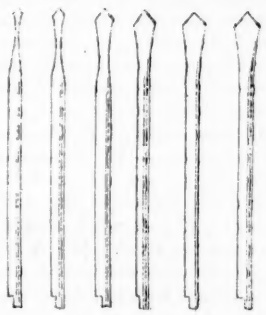

Fig. 10.

Ex. XXIX.—The drills we shall have occasion to use will be only small, their size ranging from $\frac{1}{32}$ to $\frac{3}{16}$ of an inch (measured across the broadest part of the cutting edge), consequently we shall only deal with such processes as are involved in making and working with them. Fig. 10 illustrates a series of drills of useful sizes, made from a piece of the best bright cast steel wire (B.W.G., No. 9, about $\frac{5}{32}$ inch in diameter), obtainable in foot-lengths, at any tool-shop. The steel mentioned may be relied upon as being of the necessary quality. One notable distinction in drills is that some are smaller than the wire from which they are made, while others are larger. The convenience resulting from making the several drills from a single-size wire is that they will all fit one and the same drill-stock. To make a drill smaller than the wire, cut off a piece of wire about 2 inches long, with the aid of the edge of either of the files referred to in Ex. XXIV. Hold one end of the piece of wire in the hand-vice (Ex. XXVIII), and reduce the thickness of the free end for about half-an-inch of its length. This is done by placing it in a groove cut in a piece of hard wood held in the table-vice, and then with the left hand revolving the wire inwards (and, of course, the hand-vice holding it), filing outwards at the same time with the right hand, and applying equal pressure to the file throughout the operation. The part filed should be reduced to a slightly taper point, the point being made smaller than the hole which it is intended to drill. The point is then flattened out, by placing it upon an anvil or block of iron, and spreading it with a hammer to a width slightly greater than the diameter of the intended hole, after which the point is filed at right angles to the plane of the "blade," to an angle not exceeding 100°. The sharpness of this angle will, however, depend upon the hardness of the material to be worked; for example, the angle for cutting brass would be considerably sharper than that adopted when cutting steel. It only remains now to provide the cutting edges. This is done by holding the drill in the left hand and filing the narrow sides of the flattened portion to a small angle (not exceeding 45°), filing downwards, so as to leave the higher edge nearest the body. The point previously made is similarly dealt with. The size of this last angle depends very much upon the kind of work in hand, and can only be determined after practice. To lay down a hard-and-fast rule would be impossible. When the cutting end is to be wider than the wire, heat one end of the wire to a red heat and flatten out on an anvil or iron block to the required width. There is a limit to this widening, owing to the very obvious fact that an increased width involves a reduced thickness. Having been properly flattened, the cutting edges are produced in a way similar to that adopted for the previously-described smaller drills.

Having made the drill, let us now turn our attention to the hardening and tempering processes.

Ex. XXX.—To accurately define "hardening" is a matter of impossibility. At present we can only speculate. The recent researches of Prof. Hughes (to which reference has previously been made in these pages) would seem to indicate that the superficial molecules or particles become, during the process, rigidly associated one with the other, but how this comes about or how it is maintained it is difficult even to imagine. The hardening process consists in raising the steel to a dull red-heat, and then immediately chilling, and thereby hardening it in water or oil. We often hear of workers who, with an air of mystery, show us a solution which they would have us believe possesses unusual qualities for hardening. We never yet, however, came across a single solution which was in any way superior to water or oil. With reference to the heating it may be observed that when an ordinary coal fire is used, it will be necessary to guard against over-heating or irregularly heating the steel. These troubles may be avoided by placing the steel within a piece of old gas-pipe, and then heating both together. A uniform increase of temperature is thereby ensured, while at the same time the surface of the steel is kept clean. To complete the hardening, the pipe is removed from the fire, and the steel allowed to drop out of it into the water. If a gas blow-pipe is at hand, the operation may be performed more rapidly. First heat about half an inch of the cutting end near the point of the flame to a dull red heat, and plunge it in water.

Hardening, however, is a process which renders steel very fragile, but which may be overcome by tempering.

Ex. XXXI.—Tempering is a process for restoring the tenacity to hardened steel. It consists in partially restoring the softness of the metal, the degree of softness varying with the quality of work to be performed. First clean the flattened surfaces of the drill upon an oilstone or piece of emery-cloth, care being taken not to touch the brightened parts with the fingers, otherwise some difficulty will be experienced in ascertaining when the proper degree of tempering has been attained. To temper the drill hardened in the gas-pipe, place it on a hot iron-plate, allowing the cutting end to overhang. In a very short time the overhanging portion will be seen to assume a deep straw colour. It should then be immediately dipped into water, when the necessary degree of tempering will be obtained. The immersion in water prevents softening to too great an extent. When the hardening has been performed with the aid of a

gas blow-pipe, clean the surfaces as before, and place the unhardened end in the flame, keeping it there until the deep-straw colour appears at the cutting end, when the drill should be dipped in water. After tempering, the cutting edges should be prepared for use by sharpening on an oilstone.

CHAPTERS ON MODERN DOMESTIC ECONOMY.

XVI.—THE FRAMEWORK OF THE DWELLING-HOUSE.

STRUCTURAL EXAMPLES.

IN a paper read to the Society of Arts, on Wednesday, the 13th inst., Captain Douglas Galton, C.B., F.R.S., commented most ably upon the most recent report of the "Royal Commission on Metropolitan Sewage," and gave ample evidence to show that that inquiry has at last landed us on the threshold of future activity, by a full recognition of all the evils that have to be dealt with, and the principles of action to be observed. In the substance of the paper itself, which has since been published,* and during the discussion which followed, many plans for the disposal of the sewage were brought forward; and it seems clear that the Royal Commissioners deem it advisable to get rid of the metropolitan sewage by allowing it to discharge into the sea at some place where it cannot materially affect the sanitary condition of the river, or interfere with the special duties of the Conservators of the Thames. All this seems to be quite capable of being carried out for the metropolitan sewage alone, as a sort of ready expedient at this time of dire necessity, when something must be done to obviate immediate danger. The hydraulic system is, as we have shown before, defective at its very foundations, and it will have to be thoroughly eradicated before the utilisation of the city refuse can be at all adequately, not to say perfectly, dealt with. But, in the meanwhile, the urgent necessity of the case demands that something shall be done, and the details of that something have at least been plainly indicated in the report of the Royal Commissioners.

One of the most important observations made by Captain Galton, however, is worthy of quotation here. He says:—

> But with respect to the sewage of districts outside the metropolis, the subject is largely one where future action is less fettered by former proceedings. No doubt, even if it were admitted as an axiom that sewage of outlying populations should not be allowed to flow through densely-inhabited districts, yet it is possible that sewers might be arranged to carry the sewage from the places in question to the sea. But is this necessary? or is it desirable? If sewage from places in the Thames valley above the metropolis, or from the valley of the Lea, is required to be taken to the sea, where are we to stop? The difficulties of the sewage question arise from concentration; and it is, therefore, a much more rational solution to give up the idea of concentration, and to require each district to make arrangements for the disposal of its own sewage.
>
> If a population concentrates itself on a limited area, it must make arrangements for the wants entailed upon it by that concentration. For instance, it must provide streets to give access to the houses; it must provide open spaces in which to marshal the railway trains which bring in the food or other articles which minister to the daily wants of the population. It must provide gathering grounds for its water-supply, parks for recreation, and open spaces in which to bury its dead. Similarly, it is equally necessary that every nucleus of population should provide open spaces on which to purify its sewage, without being offensive to neighbouring houses.

The logic of this last analogy is somewhat of the nature of a conclusion, *non sequitur*; but all the other items are full of sound sense, and entirely corroborate the statements we made some time since. Whilst we hold with Captain Galton, that each suburb should deal with its own excrementitious waste, we cannot for a moment endorse his opinion that that refuse need take the form of sewage, as such. We think, after what we have before stated, most of our readers will be convinced that if sewage is made in the suburbs, it must eventually find its way into the river as a potent cause of pollution. All the evidence upon this matter tends to show that in rapidly-growing districts adequate sewerage provision cannot be made; and, even if such means were capable of accomplishment, it would be out of the question for each local board to provide for its conduction to the sea on the score of overwhelming expense. The Metropolitan Board is too heavily burdened as it is to approve of any scheme which shall augment their quantity of refuse to be disposed of, and sewage farms in each district would only prove to be very expensive luxuries of questionable value; for the substance of independent and disinteresed research goes to show that the conversion of sewage sludge into valuable manure is not remunerative, but the reverse.

Last week we pointed out what an important bearing all this has upon the social demands of life in this great city, and that costly sewers are incompatible with the healthy housing of our London poor in the suburbs. We have reason to believe that, if the dry system of sewage utilisation, after the plan perfected by Mr. Conyers Morrell, were adopted in Greater London, the immediate results would be:—(1.) A possibility for dealing effectively with the city sewage until such time as further provision can be made for dispensing with the drains for human excrement. (2.) A wholesome condition of things in the suburbs and the river. (3.) A marked decrease of demand, and a consequent diminution of the water-supply, which would dispense with undue calls upon the underground distribution of waters of the Thames valley, and cause a sensible reduction in the water-rates. (4.) The commercial value of a product which would bring prosperity to the agriculturalist, and repay its cost of utilisation in many other ways, whilst at the same time it would enrich the local boards and enable them to decrease the rates and taxes. (5.) Scope for the shelter of the London poor; the working man would be enabled to enjoy all the benefits in a healthy and happy home. These are not mere idle phantasies, but plain matters of fact, which are capable of being proved from every point of view.

One objection that has been raised to prevent the abolition of sewers is, that provision cannot be made in their absence for the disposal of street refuse. In the metropolis it has been found that such an objection is at least feasible; but, for the suburbs, it has been estimated that, with properly-constructed gullies leading to surface drainage pipes, and suitable street carts, there need be no apprehension of evil from such sources.

We propose now to illustrate the principles which we have already enunciated, by means of a series of practical examples. In doing so it will be necessary for us to discuss not only structures which are to be regarded from our modern standpoint as advances, or types of perfection, but defective instances, which, on account of their prevalence in our household appointments, call for special comments of warning to those who desire to learn how best to choose a dwelling-house.

The details of the framework of the dwelling-house may, for the sake of convenience, be considered under the following heads:—(I.) The disposal of refuse, to include a description of dustbins, garbage-receptacles, and apparatus for the treatment and utilisation of solid and liquid excreta by the "dry" process. (II.) The system of house-drains and their accessories. The course of a perfect

* "Journal of the Society of Arts," Feb. 13, 1885, pp. 290–303.

system of drainage-pipes would embrace special illustrations of closet furniture, the form and disposition of soil-pipes, with provision for their suitable arrangement and ventilation; the varieties of drainage-tubes, yard-gullies, rain-water gutters and heads, the means of conveyance for sink and surface water; and last, but not least, the principal types of faulty structures, with full explanations of their defects. (III.) The water-supply. We have hitherto left this portion of the household economy untouched, because the principles of a pure supply of water were fully treated of in a former series of articles,* and also because the illustrations we shall adduce hereafter will quite fill up any gaps that may have been left. Here, as elsewhere, many evils exist; but they are more or less associated with the general system of drainage or the injudicious location of cisterns. (IV.) The system of chimney-flues, fire-places, and provisions for smoke-abatement and smoke-cure. Here the whole question of deriving warmth without vitiation or removal of the essential elements of the atmosphere is involved, and, although the value of cowls has already been detailed†, the correlation of the separate portions of the entire system remains unexplained. (V.) Ventilation. Just as the water-supply is inseparably linked to the general drainage systems of the house, so here, efficient ventilation presupposes the proper construction of chimney-flues; but, in addition, it concerns the size and general configuration of the apartments, their doors, windows, floors, &c. (VI.) Miscellanea. Here the actual shell of the building and convenience of access thereto demand attention; for upon those items does the health of the tenant and the general stability of the structure depend. Sound steps, well-ventilated basements and floors, firm foundations, prevention from damp, and many other things, although seemingly insignificant in themselves, amount to a total quite sufficient to stamp out the favourable or unfavourable character of the abode.

Editorial Gossip.

The number of the *Monthly Notices* of the Royal Astronomical Society just issued contains a paper by that eminent American astronomer, Professor Simon Newcomb, to which attention may not unprofitably be directed. Writing with reference to the suggestion that the civil (or nautical) and astronomical days should be arranged, as soon as practicable, to begin at mean midnight, Professor Newcomb suggests that the confusion and trouble incident on this change would not be confined to the present time, but "that whenever the astronomer of twenty or one hundred years hence has occasion to refer to the ephemeris, he must know and bear in mind which reckoning of time is adopted, else his place of the moon will be taken out twelve hours in error." On this and cognate grounds, he concludes that "the change is one which ought not to be made at all, unless some stronger reason for it than is now presented shall be pointed out." I have some idea that very similar objections were raised in this country in the year 1752 to the so-called "change of style" which was then made. Such change, however, did take place, and we do not, I imagine, find that chronologists of the present day are ever very seriously embarrassed by it; albeit, the days from Sept. 3 to Sept. 13 inclusive, in the year referred to, had no existence whatever.

I hear that the Presidential address at the annual meeting of the Royal Astronomical Society, this day week, was one of the dullest and dreariest ever listened to. Our informant says, pretty severely, "I understood Dr. Huggins's claims to the medal perfectly—until Mr. Dunkin explained them!"

I learn, too, that the question of voting by proxy at the annual election of the governing body of the Society has created quite a scare among certain of the present council, who are determined (*per fas aut nefas*) to hang on to seats from which the sense of the entire Society would speedily displace them. Their craven fear of inviting the opinion of the whole body of the Fellows was, I am assured, scarcely attempted to be concealed.

A curious illustration at once of the tenderness of the law for the liberty and security of the subject, and of the existence of a kind of *imperium in imperio* in this country, is afforded by the shocking death of private Brindley, of the Shropshire regiment, at Woolwich last week. It is needless to reiterate here how a sentry on duty at the Magazine was approached on a dark rainy night by a man who refused to answer his thrice-repeated challenge, and who rushing upon his bayonet was transfixed; the victim of an insane practical joke. The remarkable thing, however, is that this unfortunate sentry should have been subjected to the indignity of being dragged before a Criminal Court for simply carrying out an absolutely legal and explicit order, which he dared not disobey. All right-thinking men will grieve that private Botham's bayonet did not go through the chest of Rossa or Patrick Ford (or that of their imagined employé), instead of through that of his own comrade; although the fruitlessness of such grief must be evident when we reflect that such arrant curs take extremely good care never to put their worthless bodies within thousands of miles of the very slightest danger. It is much safer to live on the earnings of ignorant Irish cooks in New York.

From indications which have recently been apparent in the public prints of renewed active opposition to the suggested opening of picture-galleries and museums on Sunday, it would seem as though legislation on that subject were imminent. This opposition is obviously based upon the transparent fallacy that, if we only deprive the mass of the population of any means of intellectual recreation on the first day of the week, we shall, perforce, drive them into churches or chapels. We shall do nothing whatever of the sort: we shall drive a very large proportion of them indeed into the public-house, and nowhere else. The present choice afforded to the working man, between Church and the beershop, has brought forth fruits of which we have assuredly no particular reason to be proud, or to congratulate ourselves upon. To refine and elevate the tastes of the populace above mere sensual enjoyments, is to prepare a soil fitted for the reception of higher truths. To tell a man that if he will not go to church he shall sit indoors all Sunday boozing over tobacco and spirits, is to drive him into a life as needlessly degraded as it is possible to imagine.

In a lecture delivered on Feb. 3, at the Royal Victoria Hall, Professor Henslow explained the three methods by which flowers are fertilised, viz., by insects, by the wind, by self-fertilisation; and described some of the floral contrivances which facilitate the operations of insects. He further pointed out that while wind and self-fertilised plants are the most widely dispersed, those fertilised by insects are the most beautiful; at the same time calling attention to the fact that it is a mere popular delusion that self-fertilisation exerts an injurious influence in the cases in which it occurs. In an eloquent peroration, he descanted on the inestimable advantages derived by mankind from the process of evolution by natural and artificial selection.

* See this Journal, Vol. vi., p. 7, *et seq.*

† See this Journal, Nov. 21, 1884, p. 422, *et seq.*

XUM

HIGHEST TEMPERATURES ENDURABLE BY FISH.

THE following useful and interesting experiment has lately been made by Mr. W. Oldham Chambers, secretary of the National Fish Culture Association, viz., that of testing the highest temperature at which fish can exist in water. The experiment, which was tried at South Kensington in the presence of various gentlemen interested in the subject, furnishes to the public additional important facts in relation to the innate endurable power of fish.

Two specimens of the following species were selected, namely, carp, gudgeon, dace, roach, perch, minnow, golden tench, common tench, trout, and salmon. It will be seen that the selection included a range of considerable diversification, no partiality being exhibited to species. On removal from their respective tanks in the Aquarium, the fish were placed collectively in a large wooden receptacle, containing several gallons of water, registering 53°, which was gradually increased by a continual steady infusion of hot water through a pipe coiled round the bottom of the receptacle. A careful survey of the fish was taken during the progress of the operation, in order that they might be immediately removed on showing signs of expiration.

It was not until the thermometer recorded 80° that any appreciable change was observed in the condition of the fish, when it became manifest that the rising temperature was beginning to make itself felt. It was noticed, moreover, that their movements had become languid, and that their general appearance exhibited faintness and decreasing powers of vitality, with the exception of the carp and tench, which seemed to pass unscathed from the afflictions affecting their *confrères*, and to be oblivious to what was transpiring around them. In the meantime the temperature was increased, but not a single fish was overcome until 82° had been registered, when a perch suddenly became prostrated and rolled over helplessly on to its side. A supply of brandy had been placed near at hand for restorative purposes, so that immediately the perch justified the usage thereof, it was removed from the hot water, dosed with the aqua-vitæ, and placed in a can of cold water. This operation had now generally to be performed upon the other fish, which followed the example of their congener, in rapid succession, taxing to the utmost the alacrity of Mr. Chambers and assistants in their operations. Each fish was similarly treated in turn on being removed from the hot water, and afterwards placed in its natural element, according to the following statement showing the degree of temperature, together with the time of immersion and removal of the fish.

Name of Fish.	Time of Immersion.	Temperature at Start.	Time of Removal.	Temperature at Removal.
Perch	6.50	53	7.16	82
Roach	6.50	53	7.20	82½
Salmon	6.50	53	7.25	83
Trout	6.50	53	7.26	84
Minnow	6.50	53	7.27	85
Gudgeon	6.50	53	7.31	85½
Dace	6.50	53	7.32	86
Tench, Common ...	6.50	53	7.35	88
,, Golden	6.50	53	7.36	88
Carp	6.50	53	7.40	91

It will be seen by the foregoing statistics that the common tench and carp were the last to be removed, the former at 88°, and the latter at 91°; but the capacity for endurance shown by the Minnow is well worthy of note, as is also that of the salmon, which has a high standard of respiration, and therefore a greater necessity for oxygen. Although the perch was the first to feel the effects of the heat, the temperature to which it attained—viz., 82°—was extraordinary, considering its natural aversion to heat.

After the application of brandy, the fish remained in a semi-inanimate state, some exhibiting no signs of life whatever, but lay helplessly at the bottom of the tank in which they were replaced. They were thus left for several hours, when, on inspection, they were all found to be swimming about in their normal condition, with the exception of one dace, which expired. On viewing them it was impossible to detect any indication of their having passed through such an ordeal as that experienced a short time previously. —*Fish Culture Journal.*

The Nice Opera House, which was burned down about four years ago, has been rebuilt. It seats 1,500 persons, and cost £60,000.

"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office, 74, Great Queen-street, W.C.* If this is not attended to delays arise for which the Editor is not responsible.

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MIND AND BODY.

[1593]—I cannot resist the temptation to ask "F. W. H." (letter 1,580, in Knowledge of Feb. 6), through your journal (if you will allow me so to do), whether he is quite sure that what he represents to be mere truisms are necessarily even truths? He says that it is impossible there should be such a thing as free-will in man if we grant an Almighty will. Now, does he put it beyond the power of an Almighty will to will that there shall be beings who shall have a will of their own? Why should not an Almighty Creator choose to limit his own will by the creation of beings gifted with a power of free will? Does it not seem to be a limitation upon His Almightiness to deny Him such a power? To grant Him such a power seems to me not to limit His Almightiness. I do not mean to say that this consideration fully explains the mystery of free will in a creature (supposing it to exist) existing together with a supreme will of an Almighty Creator. But I think this consideration does show that what "F.W.H." takes to be a truism need not necessarily be even true.

William Fitzgerald.

[1594]—I do not think that "F. W. H." (see his letter, 1580) can expect J. W. Alexander, or any one else, to tell him what the soul does when unconscious; but if there be an immortal soul, living independently of the body after death, I do not see that its organs of sense need in any way be analogous to those the body requires, when united to the soul during life on earth.

These organs undoubtedly perish with the body at death, but that is no reason why other totally different, and infinitely more exalted, powers of perception may not be enjoyed by the immortal soul.

Eye-witness.

[What then becomes of personal identity?—Ed.]

[1595]—As one of those who hold that the beliefs almost universally held are almost invariably erroneous, I greatly object to your able correspondent, Mr. W. H. Jones, altering the lines of the immortal Shakespeare. The great thoughts of all philosophers in all times have been and are at present beyond the reach of the mass of humanity, therefore the very reverse of universal.

I am sorry to read Mr. Jones's body is comparable to a wooden part of an instrument; mine is eminently self-acting. My mental faculties, my soul, are all within, interwoven, part and parcel of my body. I cannot, in fact, separate my mental existence from my bodily one; it is quite unthinkable to me. I have never "received a blow on my mental faculties," although sometimes one on my head. Dreams are, among savages, the *fons et origo* of the idea of soul and its separate existence.—Yours truly,

F. W. H.

[1596]—The assumption that mind (or soul) and body are not *one* but *two* distinct and different, though conjoined, entities, has long appeared to me to rest upon no real scientific basis. No evidence whatever, but the mere assertion of vague hopes, analogies, beliefs, aspirations, &c., has ever been produced during man's history, so far as we know it, to inform him concerning the so-called dual nature of his being. We have not yet got beyond an *if* as to our relations to any future state; and, as to our present phase of existence, science has gone no further than to confess its in-

ability to penetrate the veil which hides in its mystery the secret of human intelligence.

Dugald Stewart's admission that mental decay was an argument against immortality—whatever such admission may be worth—cannot be set aside by "W. H. Jones's" illustration of the lady and the piano. These were two distinct and separate existences, the one acting upon and outside of the other; whereas, in the exhibition of mental phenomena, body and mind are not disunited. The essence of the matter remains, therefore, unelucidated; and, whether mind is one thing and body another, or both together only one manifestation, are points yet unsolved.

No mind has ever been found without a body; when such a phenomenon occurs, science will have to deal with it by scientific methods. Whether intelligence is merely, as some contend, a function of a living organised being, or whether it is a power acting by its own inherent force upon an otherwise senseless and inert mass, are questions very far from settlement, and the easy assertions of either affords no proof of their respective believers' knowledge of the matter. In short, until it can be shown by evidence to be intelligently apprehended that mind and matter are not identical, and can, and do, separately exist (all our knowledge up to the present time indicates the exact contrary), I think less dogmatism than is so frequently exhibited would be more becoming and appropriate. Surely it is better, totally ignorant as all are of whence we came and whither we go, to confess such ignorance, and to "suspend our judgment" instead of rushing to conclusions having no other or better foundation than a *wish* or a *hope*. Meantime, there is ample scope for science, and she may pursue the even tenor of her way undisturbed and undistracted by speculations, which however interesting, or even awful, are still but speculations, probably to our race ever so to remain. Geo. Robson.

BODY AND SPIRIT.

[1597]—A correspondent in your number for Feb. 7 likened the soul to a musician playing upon a piano—the body. Without discussing the grounds upon which this comparison is founded, might I ask your correspondent one question—what becomes of the musician when his piano is destroyed? In other words, when the body dies? Does he obtain a new piano; and, if so, is there no breach of continuity in his consciousness of his own identity? To this a negative answer is impossible; for, as we have lately read in the interesting articles on "Our Two Brains," there is oftentimes such a breach of continuity when the piano remains the same, but is for a short period out of tune and deranged.

Perhaps your correspondent will assert that, after the destruction of his piano, he exists without one. But, noticing as we pass that the same question as to the breach of continuity must meet with the same answer, even in this case, what scientific grounds have we, I ask, for asserting that the musician exists, seeing that our only evidence was that derived from his performance upon his piano, which is now non-existent?

Such inquiries as these into the union of the mind and the body belong to the realm of metaphysics, not that of physics. From a scientific point of view we must always remain in absolute ignorance as to the true nature of the soul. Whether metaphysics form a branch of knowledge, or whether they are in reality a snare and a delusion, this is not the place to discuss. All that can be said here is that, judged on scientific principles only, the verdict of the jury in the case of Materialism *v.* Spiritualism can be given to neither side. Neither the plaintiffs nor the defendants can prove their case. "Not proven" is the only possible verdict.

This is one of those numerous questions which fall without the sphere of possible human knowledge. It must ever remain a mystery to us. Strive how hard soever we will, we can never traverse the land which lies "behind the veil." In the times of the Israelites only the high priest might enter into the "Holy of Holies." Let us remember that we men are not high priests. When shall we learn the truth of the philosophical doctrine of the "Relativity of Human Knowledge"? A. F. Osborne.

BRAIN AND MIND.

[1598]—"F. W. H.," in letter 1580, asks me where is a man's soul when he is unconscious? I do not suppose "F. W. H." intended the question as a conundrum, but it reminds me rather of the riddle, "Where was Moses when the candle went out?" Moses, I imagine, was where he was before, only in the dark. So a man's soul is very probably where it was before, only in the dark. "F. W. H." seems to take it for granted that consciousness is part of the matter of or situated in the matter of the brain. Taking known phenomena into consideration, it seems to me more probable that consciousness is the reflection of the action of the brain on the surrounding æther, and what is called conscious volition the reaction of the æther on the matter of the brain. For it seems to me proved by the phenomena of light that æther and matter do act and react on another. "F. W. H." has himself shown how the image depends on the condition of the reflecting surface.

Feb. 10, 1885. Jos. W. Alexander.

MIND, BRAIN, AND SEX.

[1599]—Mr. A. F. Osborne, in his letter (No. 1466) asks "if it be possible to say that with a different training a Shakespeare might have become a Napoleon, or a Titian might have developed in a Bismarck." I reply in the negative; but then I maintain, as suggested in my letter (No. 1444), that Shakespeare, Napoleon, Titian, and Bismarck could not have been what they were had not the different parts of their brain been in harmony. It is possible that "the man whose brain had three parts each equal to seven" might "produce a greater effect, be a greater genius" than the "man all the parts of whose brain marked five"; but then the three parts, each equal to seven, must be in harmony. If one of the parts was combativeness, another caution, and the last amativeness, I question whether any great intellectual result would follow from such a brain. Mr. Hallyards, in his letter (No. 1,505) in reply to mine (No. 1,444), allows that the present "cultivation of women will probably raise the level of all their children; but then, the boys improving *pari passu* with the girls, and having already a great start (ex hyp.), the girls will never get up with them." I will admit this if Mr. Hallyards can prove that man's brain can be developed *ad infinitum*; but, if there is a limit to the development, then the girls might ultimately get up to the boys. That there is a potential power in woman's brain is proved by what women, under most adverse circumstances, have already done. I name Mrs. M. Somerville, Madame de Staël, Charlotte Brontë, Mrs. E. B. Browning, Mrs. Oliphant, and George Eliot. Women, too, are holding their own in the mathematical and other triposes at Cambridge. Several women can now write M.D. after their names. In the *Queen*, the lady's newspaper, for Oct. 30, 1830, page 399, we find mention made "of a decoration given to Mrs. E. Bovell Sturge, M.D., of Paris, Membre de la Société de Médecine Publique et d'Hygiène Professionelle. It is the custom in France to confer this decoration on persons who have distinguished themselves in scientific, literary, or educational work. Hitherto it has rarely been bestowed on a woman, and Mrs. Sturge is, we understand, the first Englishwoman who has received this honour." I still throw out the suggestion that it may be, not the size or weight of the brain, but the harmony of its parts, that causes men and women to produce great intellectual results. Of course, a large harmonious brain will produce greater results than a small harmonious brain; but there must be harmony of the parts.—Yours truly,

W. H. Jones.

THE PSYCHOLOGY OF INSTINCT.

[1600]—In your issue for Feb. 6, there was an interesting letter upon the above subject; but it seems to me that the writer has confused two radically different operations of the mind—reflex action and instinct; the former of these would, equally with the latter, fall within his definition of instinct.

Now, reflex action is unconscious neuro-muscular reaction, while instinct may be shortly defined as reflex action, into which has been imported an element of consciousness, or, as Hartmann expresses it—in instinct there is a conscious adptation to a particular end, without knowledge of what that end is.

The organic functions, the rhythmic beating of the heart, and processes of digestion and nutrition are instances of reflex action, but they are not instincts, as would appear to be the case if the definition given by your correspondent held good. The action of the new-born chicken, which, on seeing before it a grain of corn, immediately goes through a series of complicated movements in order to seize upon that grain, is properly an instinct, for an element of consciousness is present in this case which was wanting in the former.

Such movements as these may be divided into three classes—reflex actions, instincts, conscious actions. In the first the element of consciousness is entirely wanting; in the second it is present, but the movements are gone through rather by reason of inherited habit than from any exercise of individual volition; while in the third consciousness and individual volition hold full sway.

But, although there are three classes in theory and by definition, the members of each class are perpetually changing. That which was once merely a reflex action may become an instinct or even a purely conscious action; or, on the other hand, that which was once a conscious action may have deteriorated into an instinct or even into a reflex action. Thus there are two classes of instincts: reflex actions which through the accession of a conscious element

have risen one stage in the upward scale, and conscious actions which through frequent exercise have deteriorated into instincts.

A. F. Osborne.

THE CONNECTION BETWEEN MIND AND MATTER.

[1601]—With reference to the letter of Mr. W. H. Jones, No. 1581, I should like permission to make a few brief remarks. We commonly speak of a "disembodied" soul, and current theological belief assigns an intermediate state, after death, to this immaterial entity, in which it remains for a certain period divorced from matter, but still conscious or living. To this materialists demur, and go so far as to deny the existence of soul or spirit as separate entities; asking, according to their well-known theory, where soul or spirit can be when bodily faculties are paralysed? Now, it is a great assumption to say that, because physical sensation is in abeyance, soul must be non-existent. After consciousness is recovered, the original "ego" reappears, as Mr. Jones forcibly points out. But the existence of a conscious soul in a completely disembodied condition is quite another thing. I can only conceive of one genuinely disembodied spirit, and that is the spirit of the universe, which is God. Any purely disembodied spirit must in like manner be without limitation and unconditional, which, as regards humanity, is inconceivable. I therefore hold that the connection between human mind and matter is indissoluble. Mind must always have a healthy body in which—so to speak—to display itself. If the body is paralysed, the mind is practically non-existent. The intermediate state of the disembodied soul is merely a theological assumption, with no warranty from Scripture, and philosophically untenable. But we *are* told of a spiritual body, by which I understand a non-molecular, but still a material, incasement of the immaterial soul, which latter may be described as intellectual or spiritual force. I offer no opinion as to what becomes of the soul after physical death, but I feel convinced that simultaneously with that catastrophe it is clothed upon with its more ethereal and permanent garment, and wherever it may be there is one condition in which it must always find itself—namely, attached to some description of what Isaac Taylor conveniently terms a "material corporeity." H. B. L.

[How an incasement can be at once "non-molecular but still material," my acquaintance with physics is too limited to enable me to form the slightest conception.—Ed.]

HYLO-PHENOMENOLOGY *v.* ONTOLOGY.

"Come to Physics and see the Eternal."—*Schelling.*

[1602]—It is familiar knowledge that the Archimagus Kant, in his "Critique of Pure Reason," annihilated as realities the trinity of God, soul, and immortality. And that becoming terrified at the Frankenstein thus evoked, he, in a later work, "Critique of Practical Reason," rehabilitated all three venerable hypotheses. It is also well known that after the death of Frederick the Great, who was a freethinker, the great Königsberg iconoclast, nicknamed in Germany *Der Allzermalmende*, was silenced by the Prussian Government for his treatise "On Religion Within the Bounds of Reason," which was held to be a covert attempt to substitute the latter for the former. It is not, however, so well known that the author of the critical philosophy devoted the last years of his intellectual activity to the composition of a work only lately discovered, entitled, "My Passage from Metaphysics to Physics," in which he is judged to recant his former cogent ontological method of thought, just as Von Hartman has recently followed suit by his palinode *in re* "The Philosophy of the Unconscious," with the title "The Unconscious from the Standpoint of Physiology and Descent (Darwinism)." It is also well known that Dr. Thomas Brown, justly considered to be the Coryphœus of the Scotch school of moral philosophy, which he changed, by his method, into "Mental Science," published, in the year Kant died, a tract on "Cause and Effect," which demolished the doctrine of "Causes" altogether, relegating ætiology to the province of continuity of sequence, or, as stated in his own words, "that there is nothing in a cause but the fact of immediate and invariable antecedence to the change called its effect." To me this ontological infidelity on the part of these three greatest of authorities seems the strongest argument possible, short of physical demonstration, for the baselessness of metaphysics or ontology, on which transcendentalism in every form is founded. Eliminate animism, and the absolute disappears. We are left alone face to face with the material and mechanical *data* of relative or positive physical and physiological science, these two departments having been quite unified by recent chemical and histological research from Wöhler's synthesis of urea downwards, which categorically negatives any real distinction between organic and inorganic nature. Now, I desire scientifically to demonstrate, or rather to show by demonstration already established, that the monism of these great abstract thinkers is ratified by physical or physiological science Newton's law of gravitation, Lavoisier's antiphlogistic theory, and the quite chimerical notion of a vital principle in sentient being, seem unmistakingly to get rid entirely of any animating or motor factor in the worlds of brute matter or of life and mind, other than the *vis insita*, or indwelling energy of matter, organised or inorganised, itself. Spirit and phlogiston seem in the same category. I get, however, nearer the goal I have in view by what I call the *Brain theory of Mind and Matter, or Hylo-Idealism*, which, by referring every "thing"—abstract or concrete—to ideas or "thinks" engendered in the brain, makes egoism the true criterion, and, indeed, *matrix* of all things, gets entirely rid of the absolute, and leaves us "alone in our glory with the relative or solipsismal self and self alone is thus the only knowable universe. The notion of Dr. Carpenter, "C. B.," and of other animistic dualists getting behind nature to some hypothetical core or substance of phenomena, called by Kant during his mystical epoch of development *noumenon*, becomes thus a self-evident absurdity, since, strictly speaking, Nature herself is only an ideal personification of the self. And surely all can see that the idea of getting behind, or outside, or beyond self is a clean *reductio ad absurdum*. As well rave of jumping down our own throats. The mere supposition is ludicrous and grotesque. Thus primary causes, unless we elect to term self, such self being necessarily with each of us A 1, as beyond us, are nothing to us. They concern us not at all, no more than the Eidola of the Rosicrucian "philosophy." They may or may not exist, but, at all events, ontology as the absolute mystery underlying phenomena is from the necessary and benign limitation of the human mind a *terra incognita et incogitabilis* forbidden us to explore. The first duty of the sound scientific imagination, therefore, is to eradicate the vicious "cause-seeking" propensity altogether. He who succeeds not in this *sine quâ non* remains ever in *statu pupillari*, were he Newton or Faraday himself. Science can never enter into her rights, can never be mistress in her own house, till this burning question is settled, for good, once for all. Sceptics like Newton, and even Darwin, render themselves liable to the reproach Cuvier directed against Priestley, that he was a graceless father who disowned his own child. It will be remembered that Darwin withheld his "Descent of Man" for thirteen years, out of mistaken deference to the claims and scruples of spiritual ontology.

Army and Navy Club. Robert Lewins, M.D.

HUMAN AUTOMATON.

[1603]—The following circumstance affords an equally striking example of the influence of habit with that mentioned by your correspondent in No. 170, Jan. 30. From 1875 to 1878 I was employed as clerk in a manufacturing establishment situated about eight minutes' walk from my own. Almost the whole of the road between lay through a deep defile, known as the Glen, which, to a stranger, was generally very impressive, and in my four or six daily passages I often met scarcely a single passenger.

During the whole of this time I was a fairly diligent student preparing for a competitive examination, and the quietness of the road was very favourable to the studious turn of mind natural to one in such a position.

In 1878, having successfully passed my examination, I gave up my situation, and removed to London.

Eighteen months later, I was on a visit to my parents, who had, in the meantime, removed to a house in a different part of the town. During my stay, I had occasion to pass through the Glen in the direction leading to my home.

Unconsciously I fell into the habits which for nearly two years had been totally suspended. I took the road towards my former home, walked through the back yard, opened the door of the house, inhabited then by people quite strange to me, and did not discover my mistake till I stood on the doorstep. No one appearing to be in the room, I beat a hasty retreat, but not before being noticed, as I afterwards learned, by some of the family then occupying the house. Libra, B.A.

THOUGHT AND LANGUAGE.

[1604]—Permit me a few words in reply to your anonymous correspondent "Hallyards" [1,589], who, enjoying the privilege, as he terms it, of controverting statements in the teaching articles of your staff, has either not been sufficiently careful in reading my second article on "Thought and Language," or is more anxious "to have truth on his side than to be on the side of truth." I distinctly stated, on p. 64, that the problem of the origin of language is "inherently impossible of solution, since no data are given with which to work," &c.; and the passages on p. 66, to which he takes exception, are put forward simply as the most tenable hypo-

thesis which I can find. If "Hallyards" can discover a better one, by all means let him do so. But his letter really seems to indicate that he is in the position of that legal gentleman who received the message, "No case! Abuse the defendant's attorney." In very fact, besides abuse, his letter contains nothing which I think could be accepted as argument. He apparently does not consider that surrounding conditions have anything to do with the development of the human race, for he quotes the assertion that the Tasmanians were killed off by clothes as a reason that all other peoples, in whatever climes, should likewise be enfeebled by wearing clothes.

According to him, primitive man must have been more powerful than man at the present day, because the latter has been weakened by wearing clothes and living in houses.

As for the rather irrelevant and very surprising statement that "severely wounded men almost always die in hospital, but recover if chance leaves them on the field for several days," it is to be hoped, for the sake of his relations and friends, that your correspondent will not have to prove the truth of his theory in his own person. That "Primitive man may have been muscled like a lion," because "David says he tackled lions and bears when a shepherd, unarmed," is surely a *non sequitur*: for David was by no means a primitive man, but a very highly-civilised one, who both wore clothes and lived under a roof, and described his exploits in remarkably fine language, although, owing to the peculiarities of Semitic style, a great part of them may be put down for what "Hallyards" asserts they could not be—bounce.

Ada S. Ballin.

DICKENS'S STORY LEFT HALF TOLD.

[1605]—Being much interested in Mr. Foster's articles on "The Mystery of Edwin Drood," I adopted the suggestion of Mr. Proctor in Knowledge of Jan. 2, 1885, and read the story carefully, having Mr. Foster's interpretation in view. Although I am familiar with Dickens's other stories, I had never read his last unfinished one, nor had I read "H. L.'s" article in the *Cornhill Magazine*, so that I approached the subject quite unprejudiced—or rather, having previously read Mr. Foster's interesting articles, I could not help having some bias in favour of his views. I was, therefore, somewhat surprised to find that I could not agree with his conclusions, and I say this at the risk of being classed amongst the prosaic or unintelligent readers of Dickens. Mr. Foster's theory that Edwin Drood is still alive, having escaped the murderous hand of Jasper, is very attractive, and the way in which he tries to harmonise with it the various difficulties in the way is very ingenious. His explanations are in most cases quite admissible, although I think a simpler and more natural one is at hand in almost every case. But there is one fatal difficulty which he hardly touches upon, and it is this—How could Mr. Grewgious and Edwin Drood, whose characters are essentially kindly, have suffered Neville to remain for at least six months under the dark suspicion of being a murderer, the crushing effect of which upon Neville is described in chapter 17, and this merely for the sake of inflicting upon Jasper a more terrible punishment, one more in proportion to the malignancy of his crime? Surely, such a course of action would be quite opposed to the characters of Edwin and Mr. Grewgious as set forth in the story. I do not think this objection can be fairly met. Although disagreeing with Mr. Foster's theory, I cannot offer a thoroughly satisfactory one in place of it; nor do I think the data are sufficient to warrant any one being positive on the subject. I am afraid the unfinished part of the story will always remain a mystery. H. G. T.

THE ORIGIN OF MYTH.

[1606]—X has universal power; Y has no power except that of single choice. X thinks of it to exercise his power within certain limits according to the choice of Y. Where is the inconsistency?

Y, not knowing that a state of things—"m"—has been brought about by X, wishes that a similar state of things—m^1—to exist. Accordingly X brings m^1 to pass. Is there anything unreasonable in calling the similarity of m and m^1 accidental?

F. W. H. surely protests too much. Can a truism be *obvious* when it is not apparent to the vast body of non-atheists who believe in free will? An Earnest Thinker.

COOKERY FOR SCHOOLS.

[1607]—"A Chairman of School Board" asks me to recommend a simple catechism of cookery for school-girls. I wish I could. Such a book is needed, provided the catechism form should not lead to verbal cramming for examinations. The nearest approach to such a work that I have seen is a little book by a lady who lectures on cookery. "Popular Lessons on Cookery," and published at a low price by Griffiths & Farran, of St. Paul's Churchyard. It is simple and practical, free from the extravagances of the "high-class" cookery books, but rather shaky in the scientific matter, though not more so than cookery-books of much higher pretensions. This is not at all surprising, seeing how the science of the subject has been neglected by the professors of science.

W. Mattieu Williams.

THE NEED OF CLOTHES.

[1608]—"We cannot live in the 'temperate' zones of the earth without clothing." (Mr. M. Williams, p. 100.)

Is this so certain?

1. Aristophanes bewails (in the clouds) that the youth of Athens had recently given up the habit of marching (for drill) naked, with the snow on the ground. But, even then, boys spent hours naked in the gymnasia; and all athletic contests were gone through by men perfectly naked; though Thucydides tells us that this custom was copied from the barbarians. Surely all this must have been perfectly safe, or it would have been changed.

2. Some ancient friezes, &c., represent all warriors perfectly naked, save sword, buckler, helm, and greaves. They would hardly have left their kit in camp if they had had one.

3. Virgil says, "Nudus ara, sere nudus." If this farm-work was done naked in Lombardy (exposing to chills from over-heat, like war), could it be said clothes were necessary?

4. St. Peter (and, *à fortiori*, all his contemporaries) fished perfectly naked (John xxi., 7).

5. At the Saturnalia in Rome, in mid-December, young men used to run about the streets naked. They would hardly have found fun in this if it had entailed bronchitis.

6. St. Gregory the Great uses naked wrestlers as an illustration.

7. Froude cites, as an example of the barbarism of Ireland in the Tudor period, a chief named O'Kane, who comes into his own hall, perfectly naked, and sits down by the fire, having been hunting all day in that state.

8. In 1856, two women were condemned in Bedfordshire for having kept a girl, their daughter and sister, entirely without clothes, until her death at the age of seventeen. Her stomach had never been distended with a full meal, and was of the size proper for the age of five. She was kept continually at lace-making. Now, if a naked person can resist cold without natural food for seventeen years, I do not see why, with due nourishment, clothes might not be dispensed with entirely.

9. Mr. D. Urquhart kept a son of his own entirely naked for the first years of his life, night and day, in the bitter winter wind even.

10. Many persons, from sheer necessity, wear a mere apology for clothing in the severest weather.

11. Many men, from choice, wear nothing on the chest but a thin fold of linen. The chest is the weakest part. What it can bear, all the rest can, and linen is hardly to be called clothes.

12. I have often gone out in frost, in kilt, without drawers, never regretting absence of trousers.

13. Mr. Williams tries to show that the Britons could not have gone naked in winter—when "the Roman armies rarely marched." True, but how could they live in winter quarters without seeing a great deal of the natives, from whom alone they could obtain provisions? Where have I read of a Canadian chief who explained his indifference to nudity in that climate (far more severe than that of Britain as Cæsar knew it) by saying, "*I am all face!*" No doubt, if we wore cloth masks, with holes, from infancy, we should be half destroyed if we ever left them off.

14. He urges, himself, that wild beasts disputed caves with man for the sake of warmth. Indeed, lions, foxes, and rabbits have not yet discarded dens, earths, and warrens. "Sauce for the goose, sauce for the gander." If man lived *with* the beast, why not *as* they?

But if clothes are not an absolute necessity for our climate, then Mr. Williams is in error in holding that we are "foreigners" here, and that no "missing links" can ever be found in European excavations. As to man having come from the tropics, it is most improbable that the polar regions should not have produced everything long before the tropics were cool enough for even a beginning of life. You, sir, noted recently that the most ancient astronomy seems to hail from the latitude rather of Greenwich than of Babylon.

Hallyards.

FRICTION.

[1609]—In reply to your correspondent "J. Y.," the law of friction, "that the resistance due to friction is equal to the direct pressure between the surfaces multiplied by the co-efficient of friction," requires to make it true for the rolling friction of ball-

bearings in a tricycle the following all-important qualifications:—"The interposition of a lubricant modifies this law in a very remarkable manner, so that it is necessary to calculate upon a particular co-efficient of friction dependent upon the nature and state of the lubricant, and upon its mode of supply whenever any of this class of material is used." Without this qualification the statement of the law is simply misleading. As a general rule, "the thinner the lubricant the better;" but this rule again requires the qualification, "if a constant supply of the lubricant be insured."

I was not writing with the intention of making a strictly accurate theoretical statement, but only giving rough practical rules for keeping the bearings of tricycles in good order with the least possible trouble. For this reason I directed attention particularly to the lubricant to be used.

When I was writing I had in my mind some practical experiments on friction recently made by a Committee of the Mechanical Engineers, of which I can in KNOWLEDGE only quote the result:—"Before considering thoroughly lubricated bearings, it will be well to state the laws of fluid friction—that is, the friction between surfaces of liquids and solids. We have seen that friction between solids depends on the intensity of pressure between the surfaces, also on the area in contact, on the nature of the surfaces in contact; but is, at all events, for metals, *independent of the velocity*. On the other hand, the friction between a solid and a liquid is independent of the intensity of pressure and of the nature of the solid: though it depends on the liquid, it also depends on the area in contact and on the velocity. These differences will repay consideration. The experiments have shown that with good fitting and thoroughly lubricated journals, *the friction is independent of the load as long as the lubricant is not squeezed out, and that it depends on the velocity*. This fact points out that the friction is really fluid friction, and the importance of this cannot be over-estimated. It means that the bearing must fit well to insure a uniform continuous film of lubricant, and that the intensity of pressure must not be so great as to squeeze out the lubricant. Of course, the heavier the pressures the thicker the lubricant must be." JOHN BROWNING.

LETTERS RECEIVED AND SHORT ANSWERS.

A. HOWARD. Your quotation (of the source of which I am ignorant) is a mere quibble. Of course, the stars (suns) which were in existence prior to our sun emitted light, as did, in fact, our entire solar system in its inchoate or nebulous stage. What "men of science . . . once ridiculed as absurd"—and, I may add, continue to ridicule—is that *daylight*, or day and night, existed, or could possibly exist, on the earth before the sun assumed its present condition. — BECCABUNGA sends an extract from a contemporary on testing butter, in which it is stated that, if a knife-blade be drawn through oleomargarine, the place where it was pressed will look white, and its track be marked with little beads of water. Genuine butter is alleged to retain its colour under these conditions. Again, oleomargarine is said to sputter in a frying-pan; butter merely to melt and bubble. He asks if there is any truth in this? —B. VALERS (?). The twentieth century obviously cannot begin until the termination of the nineteenth—*i.e.*, of the year 1900. When a baby is born, it enters its first year; but is, of course, not one year old until it has been 365 days in the world. In the same way (if we assume the correctness of our orthodox reckoning), A.D. 1 began with the birth of Jesus, and was not complete until the expiration of twelve months, whence it must be immediately apparent that the First Century was not completed until the end of the year A.D. 100. The first day of the Twentieth Century, then, will be January 1, 1901.—TRUTH WILL PREVAIL. Had you spent the single shilling necessary to purchase Herbert Spencer's "The Man *versus* the State," and read it dispassionately through, you would have found our Reviewer was not "aspersing certain political principles," but stating a mere matter of hard, dry fact. These columns are not the place for any mere political discussion; but, if publishers send books for review, they must be content to have them honestly noticed—or consigned to the waste-paper basket. For myself, I would absolutely exclude alike the dogmatism of Lord Salisbury and the rant of Mr. Henry George from the pages of this Journal. Those who credit the conductor of KNOWLEDGE with the authorship of everything that appears in it may note, once for all, that *Mr. Proctor signs every single article, letter, and paragraph that emanates from his pen*. What is not so distinctly signed in this magazine is none of his.—EXCELSIOR. Doubtless Professor Harley has been misreported. Both Deimos and Phobos travel round Mars in the same direction. What, perhaps, he did say—although this is only a conjecture—was that, as Phobos goes round the planet in a little more than 7h. 39m., and Mars himself takes 24h. 37m. 23s. to complete one rotation on his axis, this inner satellite must rise in the West and set in the East, while the rising and setting of Deimos, the outer satellite, is normal.—F. C. THOMPSON. See reply to J. REID below.—D. H. If the construction you put upon the passage in Norie's "Navigation" be the correct one, Norie is wrong—that's all. Astronomers universally regard Dec. 31 21h. 30m. as 21h. 30m. after the beginning of Dec. 31, and would hence call Dec. 31 24h., Jan. 1 0h. But I must reiterate (and once more refer you to p. 486 of the "Nautical Almanac" for the present year for confirmation of such reiteration) that up to the 1st day of 1885 the astronomical day began at noon on the civil day. In point of fact, it does so begin in that very volume itself. I am ignorant of the address of the maker of the "Hatherley Steps." — A NON-Y. Z. Yes, entirely wrong. Read the "Pneumatics," in "Weale's Series," or any other elementary book. Your theory that earthquakes have their origin in the admission of water into the molten interior of the earth, and its conversion into super-heated steam, is (pray forgive me for saying) "as old as the hills."—COMMENTATOR. The writer is in the United States. The parallax of the Pleiades is quite insensible. In the existing state of our knowledge, they are at an infinite distance. No doubt the individual members of the group are at stupendous distances (in comparison, that is, with mean distance of Neptune from the sun) from each other. I do not see why there should not be "night skies" to inhabitants of worlds circulating round individual suns in such a group. Writing which words suggests to me to add that these suns are already formed. What we see in the heavens is nebulæ in all stages, from the mass of luminous gas, through a centrally-condensed spherical aggregation, to the incipient stars or suns. You are under an utter mistake about the resolution of the nebula in Orion. Our greatest living English spectroscopist, Dr. Huggins, has shown it to consist of a mass of glowing gas; so Brewster was simply talking nonsense. There are numerous undoubtedly gaseous nebulæ in the sky. Did you ever hear of spectrum analysis? The bigger a telescope, the more light it grasps, and the smaller the stars it renders visible. It does not follow, though, by any means, that the smallest stars are the farthest off. We have this curious proof that many of the groups of stars in the heavens are physically connected: that they are all moving in the same direction in space. A striking example of this is seen in Ursa Major. We can only reason from analogy as to the habitability of the members of our own solar system. We can, and do, know less than nothing of the millions of worlds revolving round other suns than ours.—POINGDESTRE-MESNIER ET CIE. Should have been addressed to the advertising department.—J. C. S. What you describe seems to be simply a waking dream, started by excitement of the retina. It scarcely possesses sufficient scientific interest to warrant its insertion.—AKSHAY KUMAR DAS. Forwarded to the publishers.—F. W. H. Will be printed, subject to the excision of the theological paragraph.—J. REID. Forgive me if I say that I cannot give up the space to your long defence of your hypothesis. Do you know that water is found in small cavities in the quartz of granite, &c.? Cast iron *may*, like bismuth and antimony, quite possibly undergo slight expansion at the very instant of its passage from the liquid to the solid state; but this is really irrelevant in connection with your argument; because, for example, granite—of which I have just spoken—can never have been actually molten.—H. HANKS. A patent was granted, but it is now void—W. G. WOOLCOMBE. I fancy that the questions which have been set are published, but I am ignorant by whom. The head office is at South Kensington, London, S.W. Try Williamson and Tarleton's "Dynamics," published by Longmans & Co.—ANTHROPOLOGICAL INSTITUTE. Crowded out unfortunately by press of matter.—G. H. DUNN asks for authenticated instances of hybrids breeding. Our correspondent is dissatisfied with Haeckel's illustration of the hare-rabbit. I can supply none myself, and would only remark that Darwin attributes the seeming non-fertility of hybrids to the fact that in experimenting they have been mostly bred in and in.—J. SMITH. You have got hold of a Gregorian reflecting telescope. Remove your red glass, turn the open end of the tube towards the shipping in the Downs, look through the "microscope," and focus by the arrangement which shifts your "small reflector."—S. E. PHILLIPS. Forwarded to the publishers.—M. SEGOND. Can only appear as an advertisement.—COMMENTATOR. Marked for insertion. —THOMAS AYERS. I have read your letter and your article in the newspaper, neither of which give (or, in fact, can give) any indication of the way in which heat produced by concussion or compression can, in any sense, have its origin in "processes of chemical change." Pray obtain and carefully read through Clerk Maxwell's "Theory of Heat," in Longmans' "Text-books of Science."

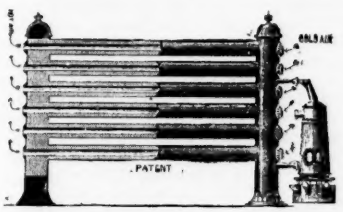
THE dividend of the Telegraph Construction and Maintenance Company was in all 20 per cent. for last year.

Our Inventors' Column.

We give here, week by week, a terse description of such of the many inventions as we think may be of use to our readers. Where it is possible, the number of the patent is quoted, to enable those who desire fuller information to procure the specification from the Patent Office in Cursitor-street, Chancery-lane. We shall, generally speaking, confine ourselves to the more recent inventions; but it often happens that an article comes under our notice which, although not quite novel, is worthy of mention for its utility and ingenuity. In such a case we should not hesitate to refer our readers to it. And while we thus increase the interest of our pages, we at the same time assist the inventors by giving greater publicity to their inventions (KNOWLEDGE *being a popular magazine*) *than is accorded by the most excellent trade journals.*

THE CHALLENGE HEATING APPARATUS.

[Patent, No. 11,598, 1884.]—The subject of this patent, taken out by Mr. Poore, of Cheapside, London, is a simple, cheap, easily-managed, and effective heating apparatus, whilst it requires but the minimum of attention. It consists of 18 ft. of 2½-in. pipe, 21 ft. of 2¼-in., and 4 ft. of 3½-in., and forms a complete radiating heating coil of great efficiency. By using double tubes, a larger heating surface is obtained with less water, and consequently a less expenditure of fuel. The ends are left open at top, so that the water can be easily supplied. The caps prevent any dirt or dust entering into the coil, and may, if necessary, be taken off. The cold air, by passing through the tubes, enters the apartment or building warm, and ensures a free circulation of fresh air, as shown by the arrows.



The apparatus may be termed self-acting, and claims as its distinguishing feature that it has extraordinary economical heating power, which does not depend alone on its large radiating surface, but which is principally attributed to the numerous currents of fresh warmed air, which are expelled by the respiratory or ventilating tubes.

It occupies but a small space, being only 33½ in. high and 3 ft. 6 in. long. The boiler is made of copper. The wicks are fitted with a water-well, to prevent an explosion or the evaporation of the oil. It will burn for 48 hours without any attention, consuming only two quarts of oil. The arrangements for trimming, cleaning, and regulating the lamps are simple and easily understood. If gas is used, the consumption is regulated to 4 ft. per hour. A smoke-pipe is added to carry off the noxious fumes arising from combustion. The boiler can be placed in any position, either within or outside the house, and the connecting pipes lengthened for the purpose. The stove may also be arranged to burn coke at a cost of 2d. for every 24 hours.

MARINE RAIN-GAUGE.

MR. W. G. BLACK, F.M.S.S., has invented a gauge for the collection and estimation of rainfall at sea on board ship. It is a cylindrical vessel, open at the top and with a conical bottom, as in a wine bottle, projecting upwards. It is poised on an upright pivot, projecting into this from the floor of the square box that encloses it, and is thereby maintained in a horizontal position in all the rolling movements of a ship. The gauge is formed of two parts, that fit into each other half-way down, the collector on the top and the receiver below. At the bottom of the collector is a diaphragm, perforated with holes for the passage of the water into the receiver below, which will also check evaporation of collected rain, and prevent the upward splashing of the fluid by lurching of the ship. From the bottom of the receiver is projected a right cone, hollow from below, which constitutes its floor, so that the rain collected in it will lie in the space between the cone and the enclosing cylinder. The contents of the receiver may be emptied after disconnecting the collector on the top, and measured by the usual glass measure graduated to parts of inches of rainfall. The apparatus is made in a portable form, and may be placed in any convenient position.

GAUGE FOR CASKS, &c.

[Patent No. 3,238. 1884.] Mr. F. W. Denison, of Hull, has patented a device for ascertaining the height of liquids in casks, barrels, and other vessels. The object of this invention is to provide a simple and inexpensive apparatus to be applied to casks, &c., containing beer, wine, and other liquids, for the purpose of ascertaining the height of such liquid in the cask or other vessel which has been tapped, whereby a register may be kept of the contents of each cask or vessel at the end of each day. A small tap or hollow metal spile is inserted into any convenient part of the cask or barrel, preferably underneath. This tap is connected by means of a union joint to a flexible tube, which is connected in a similar manner with a vertical gauge-glass or tube, secured in any convenient manner to a metal holder or scale, which may be secured to the side of the cask, this scale being divided off to represent inches, pints, or any other convenient measure. The small tap, on being turned, will allow the liquor to run into the gauge-glass, and the height of the liquor in the glass, which will be the same as that in the cask, may be taken and entered in a register. If this reading agrees with the reading taken in the morning, before any of the contents are drawn from the cask, it will be seen that the cask has not been tampered with during the night, and a check will thereby be obtained on the employés, &c. The end of the tube may be left open to allow for the escape of the air, but to prevent evaporation, in the case of spirits, a spring stopper may be employed to close the opening. The drawing-off tap will be entirely separate from the gauging apparatus.

INFECTIOUS DISEASES.

[Patent, No. 8,209, 1884.]—Mr. Gayton has patented a device for "preventing the escape of infectious particles from vehicles," which consists of two perforated frames, with the intervening space filled in with cotton-wool or other absorbent material, impregnated with a suitable disinfectant. A number of these appliances are fitted at such parts of the vehicle as may be deemed necessary.

AN IMPROVED ERASING KNIFE.

[Patent No. 2,867, 1884.]—Every one who has ever had occasion to use an erasing knife must know how utterly unfit for writing on, the process of removing previous ink-marks renders paper. The novelty under review combines, in a simple and effective manner, with an ordinary eraser a paper-smoother, a few moments' application of which restores to the roughened paper its smooth surface, and thus, at the same time, fits it to receive fresh writing and almost completely removes every trace of the erasure. The smoother consists in a peculiar conformation of the handle, which is composed of porcelain, ivory, or other hard substance capable of taking a smooth, polished surface. The part of the handle furthest from the blade is shaped for a short distance along it on one side slightly convex, and rounded off at the extremity, and with a smooth, polished surface, which, being rubbed lightly and quickly over the roughened paper, effectually smooths it. On the other side there is a slight concavity, so that when the convex surface is on the paper the concave surface is perpendicularly above it, and thus admits of the forefinger being placed in the hollow to steady the handle, and give the hand a firm hold of it while smoothing the roughened paper. The patentee is Mr. William Steen, of 54, Fitzroy-avenue, Belfast.

NOSEBAG FOR HORSES.

[Patent No. 7,643, 1884.]—Mr. H. C. S. Goldfrap has taken out this patent relating to the fittings of nosebags. The nosebag is suspended by a strap, which passes through a ring on a headstrap, and is attached to the saddle. The bag is also connected by another strap with the bottom of the collar. The first strap enables the horse to reach the food easily, and the latter prevents the tossing of the nosebag.

ACCORDING to the *Electrician*, the following is a summary of the Eastern Telegraph Company's system, with its connections:—Cables: Eastern Telegraph Company, 19,121 miles; Eastern and South African Company, 3,864 miles; Black Sea Telegraph Company, 351 miles; Eastern Extension Company, 12,612 miles; total length of cables, 35,948 miles. Land lines: Eastern Telegraph Company, 3,345 miles; Eastern and South African Company, 6½ miles; Black Sea Telegraph Company, 27 miles; Eastern Extension Company, 24 miles; total length of land lines, 3,402½ miles.

XUM

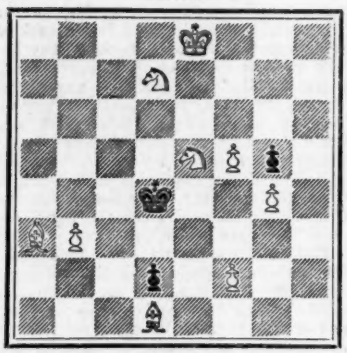
Our Chess Column.

By Mephisto.

PROBLEM No. 148.

By Edw. Carter.

Black.



White.

White to play and mate in three moves.

One of twenty-one simultaneous games played at Workington January 24, 1885:—

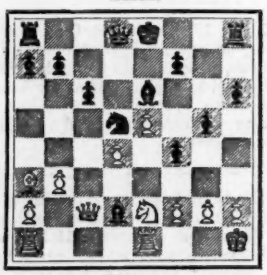
French Defence.

White. Mr. Gunsberg.	Black. Mr. T. Blain.	White. Mr. Gunsberg.	Black. Mr. T. Blain.
1. P to K4	P to K3	20. Kt to Q2	B × Kt (*f*)
2. P to Q4	P to Q4	21. Q × B	P to KR4
3. QKt to B3	B to QKt5(*a*)	22. Kt to B3	P to R5 (*g*)
4. B to Q3	QKt to B3	23. Kt to K4 (*h*)	QR to QKt sq.
5. Kt to B3	P to KR3	24. QR to QB sq. (*i*)	P to R6
6. P to K5	B to Q2	25. P to Kt3	P × P
7. Castles	KKt to K2	26. BP × P	P to Kt5
8. QKt to K2	Kt to B4	27. R to QB5 (*j*)	K to Q2
9. B × Kt	P × B	28. R to QR5	QR to QR sq.
10. Kt to Kt3	P to Kt3 (*b*)	29. B to Q6	K to B sq.
11. P to B3	B to R4	30. KR to QB sq. (*k*)	Kt to K6 (*l*)
12. R to K sq.	B to Kt3	31. P to Q5	B to Q2
13. K to R sq.	B to K3	32. P × P	B × P
14. P to QKt3	Kt to K2 (*c*)	33. R frm R5 to B5	Kt to B4 (*m*)
15. B to R3 (*d*)	P to B5!	34. R × B (ch)	P × R
16. Kt to K2	P to Kt4	35. R × P (ch)	K to Kt2
17. P to B4	P to QB3	36. Q to Q5	Kt to Q2
18. P × P	Kt × P (*e*)	37. Kt to B5	Mate
19. Q to B2	B to R4		

NOTES.

(*a*) B to K2, or Kt to QB3, or KB3 is better.
(*b*) A useful move, strengthening the position.
(*c*) Evidently with the intention of playing P to QB4.
(*d*) This leads to trouble, as Black advances on the K's side.
(*e*) The Kt is well posted on Q4.

Black.



White.

(*f*) A judicious capture. It deprives White of any immediate hope of playing Kt to K4, and to obtain a promising check on Q6. Black's position is strong.

(*g*) An error of judgment. Black should have exchanged the Kt's, when he would have remained with a safe draw in hand, there being B's of opposite colours, the position, however, being slightly in his favour.

(*h*) This turns the table in favour of White.

(*i*) One of those preparatary waiting moves made by instinct. Of course after Kt to Q6 (ch), the K will have to play on to the Q's side, on account of the discovered check (if K to B sq. by the B on R3) then possibly the R on QB sq. will come into operation.

(*j*) Threatening R × Kt! followed by Kt to B6 ch! winning the Q.

(*k*) Making the most use of one's pieces is the surest road to victory.

(*l*) This admits of a strong reply. If, instead of Kt to K6 30. P to Kt3, 31. Q to K2, &c.

(*m*) In the vain attempt to save the piece; but, if instead of Kt to B4, K to Q2, White wins easily with R × B, followed by B discovering check, &c.

The Cost of Iron Bridges.—A great reduction in the cost of iron bridges and their construction has taken place within late years. When the South Side or Kernville Bridge was built, some years ago, its actual cost was over 18,000 dols. The Lincoln Bridge, a much better structure, just completed, cost but 11,000 dols. The bridge over the Conemaugh at Blairsville, more than twice as long as the South Side Bridge, fully as wide, with four times as much masonry, in which the best of dressed stone has been used, will cost, when completed, but little over 14,000 dols. Not only is iron bridge building much cheaper than formerly, but the structures are superior in many respects.—*Johnstown Tribune.*

Remarkable Prophecy.—In a little shilling volume entitled *The Siege of London*, reviewed on p. 56, in which the author hides his identity under the pseudonym of "Posteritas," the not very remote incidents of British disaster in the Soudan were thus foretold. On page 4 of the work in question we read: "All this slaughter, however, and the unspeakable suffering and misery that followed in its train, effected no purpose, beyond proving the magnificent valour of the Arabs and the splendid fighting powers of the British soldiers. The Mahdi's power was not crushed; the British troops were ordered to retire, and garrison after garrison in the Soudan were given over to rapine and slaughter." Although the British troops have, happily, not really been ordered to retire, the terrible event which has just shocked the country gives sufficient emphasis to the remarks of "Posteritas" to render them worthy of note in the present juncture of affairs.

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NOTICES.

Part XXXIX. (Jan., 1885), now ready, price 1s. 3d., post-free, 1s. 6d.
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